Bitcoin as a new asset class

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Abstract

Purpose – Bitcoin is the best-known cryptocurrency which currently holds the largest market capitalisation and is regarded as a standard example of a cryptocurrency. There is, however, no consensus as to the nature of the Bitcoin. The purpose of this paper is to determine whether Bitcoin represents a new asset class by building on prior research.

Design/methodology/approach – The prior literature on asset classes is explored in detail and then applied to the Bitcoin. Four key criteria of asset classes are discussed, namely, investability, politico-economic profile, correlation of returns and risk-reward profile. Statistical techniques are used to inform the conclusions for the third and fourth criteria.

Findings – This research finds that the Bitcoin represents a distinct alternative investment and asset class. There are significant opportunities for investment. The politico-economic profile of the decentralised and consensus-based Bitcoin is dissimilar to other asset classes. The Bitcoin shares little or no correlation with other asset classes. Using Sharpe Ratios, it is shown that the Bitcoin provides risk-adjusted returns over and above most asset classes.

Research limitations/implications – The aim of this research is to present a normative exploration into the asset class nature of the Bitcoin and, as a result, the aim is not to create positivist generalisable conclusions. This paper does not address cryptocurrencies, other than Bitcoin and does not constitute a detailed manual on modern portfolio theory.

Originality/value – This research adds to finance paradigm research on the Bitcoin by including a developing country perspective on Bitcoin as an asset class as prior studies have concentrated on developed country settings. Further, this research introduces recent economic data (2014 to 2017) in the form of daily observations to enhance prior understanding. It is important to understand if the Bitcoin represents an alternative investment and new asset class as this may affect investment decisions.

Keywords Finance, Portfolio diversification, Bitcoin, Sharpe ratio, Cryptocurrency, Asset class

Paper type Research paper

1. Introduction

Cryptocurrencies are becoming widespread throughout the world (Hileman and Rauchs, 2017). Cryptocurrencies have been used in a variety of ways, from means of payment to speculative trading assets, and, importantly, investments as stores of value (Narayanan *et al.*, 2016; Ram *et al.*, 2016; Antonopoulos, 2017). Commentators note that cryptocurrencies are becoming more integrated into society than ever before (European Central Bank, 2012, 2015; He *et al.*, 2016).

Cryptocurrencies are so named because they rely on a branch of mathematics known as cryptography to ensure the security of transactions (Narayanan *et al.*, 2016). Cryptocurrencies are digital, without a physical form (Chuen, 2015; Kelly, 2015) and are not governed by any central entity – they are decentralised (Nakamoto, 2008; Emery, 2016).

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They are, rather, controlled by computer nodes in a peer-to-peer network where all transactions are recorded on an immutable public ledger called the blockchain (Chuen, 2015; Franco, 2015).

There has been a significant focus on a cryptocurrency known as the Bitcoin, evidenced by a comprehensive database compiled by Decker (2017). With this focus on the Bitcoin, it is important to note that there are many other cryptocurrencies (Hileman and Rauchs, 2017). Examples of other cryptocurrencies include Ethereum, Ripple and Bitcoin Cash (Hileman and Rauchs, 2017) which are the next largest cryptocurrencies by market capitalisation (CoinMarketCap, 2018). Bitcoin is regarded as a standard example of a cryptocurrency (Burniske and White, 2017) and was chosen for this study because it is the largest cryptocurrency by market capitalisation (CoinMarketCap, 2018). The market capitalisation (at the time of writing) of Bitcoin is over US$1.8bn (CoinMarketCap, 2018).

Focusing on Bitcoin is also appropriate given that the characteristics of other cryptocurrencies differ from the Bitcoin. As an example, the next three largest cryptocurrencies by market capitalisation will be discussed and compared to Bitcoin:

(1) Ethereum has gained popularity due to its ability to run decentralised applications also known as smart contracts (D'Alfonso *et al.*, 2016; Ethereum Foundation, 2016). As a result, its use cases significantly differ from the Bitcoin (Hileman and Rauchs, 2017).

(2) Ripple does not use a blockchain, has no miners and is mostly used by large institutional actors making it significantly different from the Bitcoin which uses miners to verify transactions by many difference participants added to a blockchain (Burniske and Tatar, 2017; Hileman and Rauchs, 2017).

(3) Bitcoin Cash is the most similar to Bitcoin, but represents an ideological spin-off due to differences in how the Bitcoin network should operate (Horizon Kinetics, 2017; Falcon Private Bank, 2018).

The most notable stance taken by Bitcoin Cash is that the size of the blocks added to the blockchain in the Bitcoin network are too small, thereby, making the network slow (Horizon Kinetics, 2017; Falcon Private Bank, 2018). This split of the Bitcoin code (technically known as a "fork") that formed the theoretically faster Bitcoin Cash network has received limited acceptance and support (Horizon Kinetics, 2017; Falcon Private Bank, 2018) setting it apart from the Bitcoin.

Studies on the information technology impact (Jacobs, 2011; Luther, 2013; Lischke and Fabian, 2016; Reynolds and Irwin, 2017), legal impact (Greebel *et al.*, 2015) and the accounting (Ram *et al.*, 2016) and tax (Ram, 2018a, 2018b) implications of the Bitcoin have been undertaken. While there have been limited studies on the potential asset class nature and portfolio diversification effects of cryptocurrencies, these studies are based on the markets of developed countries (Brière *et al.*, 2015; Eisl *et al.*, 2015; Carpenter, 2016; Gangwal, 2016; Burniske and White, 2017; Krause and Pham, 2017). As a result, there is a need for finance paradigm research in developing countries. Further, this research introduces recent economic data (2014 to 2017) in the form of daily observations to enhance prior understanding as to whether Bitcoin represents a new asset class.

From a practical perspective, it is important to understand whether the Bitcoin represents a new asset class because this can affect the investment decisions by individuals and investment firms alike. Diversification across asset classes offers substantial returns in the long term (Philips *et al.*, 2012). Additionally, modern portfolio theory prescribes methods to reduce investment risk (Markowitz, 1959; Shipway, 2009; Malkiel, 2015) and, if Bitcoin is a new asset class, this will inform portfolio construction. Traditional portfolios place little reliance on alternative assets, assets that have their own unique economic and behavioural characteristics apart from shares and bonds (Burniske and Tatar, 2017). Recently, however, alternative assets are being investigated to determine how they can create value, positively influencing adoption (Burniske and Tatar, 2017). This research aids in understanding Bitcoin as an alternative asset and adds to the growing body of asset class research which has, in recent years, explored, among others, art (di Torcello, 2010), infrastructure (Bianchi and Drew, 2014), intermediary asset pricing (He *et al.*, 2017) and wine (Masset and Henderson, 2010).

There are some delimitations to be noted. This paper does not constitute a detailed quantitative manual on modern portfolio theory. The aim is not to create positivist generalisable conclusions but to present a normative exploration into the asset class nature of the Bitcoin. As a result, the methods used are foundational in nature, as compared to Brière *et al.* (2015), but are consistent with other studies (Eisl *et al.*, 2015; Carpenter, 2016; Gangwal, 2016; Burniske and White, 2017; Krause and Pham, 2017). In addition, this paper does not address cryptocurrencies, other than Bitcoin, but Bitcoin is the largest cryptocurrency making it a suitable choice.

The rest of this paper is structured as follows. Section 2 deals with explaining and defining the concept of an asset class. Section 3 analyses the Bitcoin under the criteria per Section 2 and includes a discussion around the Bitcoin as an asset class under each criterion. Section 4 provides a discussion around the overall results and concludes the paper.

2. Asset class

In this section, the prior literature dealing with the concept of an asset class is explored. The concept of risks and returns and their interaction is an integral part of investing (Markowitz, 1959; Shipway, 2009, p. 66; Bodie *et al.*, 2014, p. 10). Not all investable assets such as shares, bonds, real estate and commodities (to name a few) bear the same risks and returns (Markowitz, 1959; Shipway, 2009; Bodie *et al.*, 2014). The concept of asset classes allows for grouping those investable assets that have similar risks and returns (Markowitz, 1959; Shipway, 2009; Bodie *et al.*, 2014). Investing in multiple asset classes, also referred to as diversification, assists in managing risk in portfolio management, wealth preservation and hedging, making it of integral importance to investors (Shipway, 2009; Philips *et al.*, 2012; Kneafsey, 2015; Malkiel, 2015).

The characteristics of an asset class are identified in Section 2.1, and Section 2.2 provides detail on each of the asset class characteristics identified.

2.1 Defining an asset class

The allocation of assets in a portfolio is a major factor for successful investing (Vanguard, 2015). In order to make this decision appropriately one must understand what defines an asset class. Greer (1997) first coined the concept. It is noted that an asset class is:

> A set of assets that bear some fundamental economic similarities to each other, and that have characteristics that make them distinct from other assets that are not part of that asset class [. . .] (Greer, 1997).

While this was the beginning of the asset class model, there is no universally accepted definition of an asset class (Mongars and Marchal-Dombrat, 2006; Bianchi and Drew, 2014; Burniske and Tatar, 2017; Burniske and White, 2017; Smith, 2017). As a result, this concept has been explored in detail and has developed over time (Oberhofer, 2001; Mongars and Marchal-Dombrat, 2006; Bianchi and Drew, 2014; Burniske and White, 2017). The development of the concept of an asset class will be further explored, followed by the identification of similarities so that amalgamated criteria can be determined for this study.

A study by Oberhofer (2001) placed emphasis on the investability aspects of the asset class. It was determined that an asset class must display six characteristics (Oberhofer, 2001):

(1) The assets in the class should be alike, reinforced by Smith (2017). Mader *et al.* (2010) determined that asset classes contain investments with similar features, including similarities in their risk and return characteristics and their sensitivity towards major market factors.
(2) Returns of the assets in the class must be highly correlated with each other.
(3) The asset class should be able to comprise a significant fraction of the investment opportunity set. This is also bolstered by the findings of Smith (2017).
(4) Data regarding price and composition should be easily available.
(5) Passive investment must be possible.
(6) All the defined asset classes should equal an approximation of the entire investment opportunity set.

On the other hand, Mongars and Marchal-Dombrat (2006) noted that an asset class must exhibit three characteristics:

(1) The ability to provide returns in excess of the risk-free rate.
(2) Low or negative correlation with other asset classes.
(3) The inability to be replicated through a combination of other assets.

Further insights can be drawn from an investigation into art as an asset class (di Torcello, 2010), with three key determinants:

(1) Structuring variables within the economic, social and technological spheres must support the growth of the market for the asset class.
(2) Financial performance of the asset class, including correlation to other assets.
(3) Valuation of the assets in the asset class, including the transparency of valuation data.

Burniske and White (2017) used Greer's (1997) foundation to establish the following criteria which can be used to evaluate asset classes, specifically the Bitcoin:

- Investability;
- politico-economic features;
- correlation of returns; and
- risk-reward profile.

Greer's (1997) criteria, applied by Burniske and White (2017), forms an appropriate starting point for a robust definition of an asset class. To build the asset class definition, similarities in the above are identified and grouped. Investability comprises criteria (iii), (iv), (v) and (vi) of Oberhofer (2001). Investability can also subsume Smith's (2017) criteria and criterion (iii) of di Torcello (2010). Politico-economic features include criterion (i) of Oberhofer (2001), criterion (iii) of Mongars and Marchal-Dombrat (2006), criterion (i) of di Torcello (2010) and the criteria of Mader *et al.* (2010). Correlation of returns includes criterion (ii) of

Oberhofer (2001), criterion (ii) of Mongars and Marchal-Dombrat (2006) and criterion (ii) of di Torcello (2010). Risk-reward profile includes criterion (i) of Mongars and Marchal-Dombrat (2006).

The following represents an amalgamated list of criteria with which to evaluate an asset class:

- Investability including opportunities for passive investment and the availability of price and composition data.
- Politico-economic features and the inability to replicate the asset class, using other assets.
- Close correlation of returns within the asset class and limited correlation with assets outside of the asset class.
- Risk-reward profile including providing returns in excess of the risk-free rate.

2.2 Detail on the characteristics of an asset class

This section expands on the characteristics which will be used to frame an asset class, as determined in Section 2.1.

2.2.1 Investability. Investability encompasses the provision of opportunities to invest in the asset class, including the provision of sufficient liquidity in the market (Burniske and White, 2017). There must also be opportunities for passive investment in the asset class (Oberhofer, 2001). Passive investment entails investing so as to track market movements of the asset, without directly investing in the underlying asset itself (Malkiel, 2003). This is also known as an indexing strategy (Malkiel, 2003).

The ability to invest is underpinned by making sound financial decisions, and this must be facilitated through data regarding price and composition being available (Oberhofer, 2001; di Torcello, 2010).

Finally, the asset class should be able to comprise a significant fraction of the investment opportunity set (Oberhofer, 2001; Smith, 2017). If there were insufficient capacity in the asset class, the cost of the investment would increase, lowering the liquidity in the portfolio (Smith, 2017).

2.2.2 Politico-economic features. The key criterion here is that the assets within an asset class are alike (Oberhofer, 2001; Mader *et al.*, 2010; Smith, 2017). This allows for opportunities for diversification to be highlighted (Smith, 2017). If the assets in the asset class are not homogenous, then it will be more efficient to stratify the asset class into other groups, as opposed to having opposite interactions within the asset class itself (Smith, 2017).

The politico-economic features can be further broken down into three categories:

(1) basis of value;

(2) governance; and

(3) use cases (Burniske and Tatar, 2017; Burniske and White, 2017).

These three categories encompass the economic, social and technological factors which support the growth of the market for the asset class (di Torcello, 2010).

Basis of value refers to how the asset class derives its value from tangible assets and/or underlying properties (Burniske and White, 2017). Using gold as an example, it derives value through its physical properties and its scarcity which allows it to function as a unit of account (Burniske and White, 2017).

The governance category looks at how control of the asset class is maintained (Burniske and White, 2017). There are three spheres of governance of assets in general:

(1) the procurers of the asset;
(2) the holders of the asset; and
(3) regulatory bodies (Burniske and Tatar, 2017).

In the case of gold, governance is determined through economic factors in the mining community who are the procurers and the laws implemented by governments who are the regulators (Burniske and White, 2017).

The use cases then address how the assets within the asset class can be applied in the world. Gold has multiple use cases and has functioned as a store of value, a consumable and a transformable asset (for electricity circuits) (Burniske and White, 2017).

Of importance is the fact that the politico-economic features of the asset class cannot be replicated using combinations of other assets (Mongars and Marchal-Dombrat, 2006). If the features could be replicated using other assets, then there would be little reason to coin a new asset class.

2.2.3 Correlation of returns. Correlation is a standard measure of how assets move together (Philips *et al.*, 2012; Burniske and White, 2017). Returns of the assets in the class must be highly correlated with each other (Oberhofer, 2001). Additionally, there should be a low or negative correlation with other asset classes (Oberhofer, 2001; Mongars and Marchal-Dombrat, 2006; Burniske and White, 2017).

Correlation coefficients also indicate the ways in which the assets can be used for portfolio diversification purposes, as first explored by Markowitz (1959). Table I depicts the impact on risk of the correlation values.

The greater the negative correlation, the more diversification the asset provides, according to modern portfolio theory (Markowitz, 1959; Philips *et al.*, 2012; Malkiel, 2015; Burniske and White, 2017). This means that the assets move by the same amounts but in opposite directions (Markowitz, 1959; Philips *et al.*, 2012; Malkiel, 2015; Burniske and White, 2017). Assets with greater positive correlation provide reduced means of portfolio diversification, with a perfect one correlation indicating that there is no diversification possible (Markowitz, 1959; Philips *et al.*, 2012; Malkiel, 2015; Burniske and White, 2017). Assets with a correlation near zero provide evidence that there is no link in market behaviour (Markowitz, 1959; Philips *et al.*, 2012; Malkiel, 2015; Burniske and White, 2017).

2.2.4 Risk-reward profile. The risk-reward profile deals with risk taking the shape of volatility and reward in absolute values for investing in the asset class (Burniske and Tatar, 2017; Burniske and White, 2017). This can be effectively measured using the Sharpe ratio which shows returns per unit of risk accepted (Sharpe, 1966). It is further noted that returns

Table I. Correlation coefficient and effect of diversification on risk

Correlation coefficient	Effects of diversification on risk
+1.0	No risk reduction is possible
+0.5	Moderate risk reduction is possible
0	Considerable risk reduction is possible
−0.5	Most risk can be eliminated
−1.0	All risk can be eliminated

Source: Malkiel (2015, p. 200)

in an asset class must be in excess of the risk-free rate (Mongars and Marchal-Dombrat, 2006).

Using the Sharpe ratio, assets can be compared and the greater the Sharpe ratio, the greater the compensation to investors for the accepted risk (Sharpe, 1966; Burniske and Tatar, 2017; Burniske and White, 2017).

The Sharpe ratio can be visualised as follows (Sharpe, 1966; Bodie *et al.*, 2014):

$$\frac{\text{Risk premium (expected return} - \text{risk–free rate)}}{\text{Standard Deviation of excess return}}$$

A positive Sharpe ratio indicates that the expected returns exceed the risk-free rate, making the excess return positive (Sharpe, 1966; McLeod and van Vuuren, 2004). Sharpe ratios are negative when the excess returns are negative as a result of the expected returns being less than the risk-free rate (Sharpe, 1966; McLeod and van Vuuren, 2004).

3. Application to Bitcoin

In this section, the Bitcoin is analysed based on the criteria of an asset class as determined in Section 2. Part of this analysis involves determining the correlation to other assets (Section 3.3) and the method for this analysis is also discussed here.

3.1 Investability

The Bitcoin can be traded on multiple exchanges throughout the world and examples of exchanges include Bitstamp, Coinbase, Kraken (Buy Bitcoin Worldwide, 2017) and South African exchanges Luno and Ice3X (van Vuuren, 2017). As a result, there are opportunities to invest. Most exchanges support Bitcoin trading (Hileman and Rauchs, 2017; Schroeder, 2017). These exchanges, as with traditional corporate and asset exchanges (Oliver Wyman, 2016), fulfil a vital role in providing liquidity to the market. Globally, there has been an increase in trading volumes, with a caveat that these figures are self-reported without any third-party verification (Burniske and Tatar, 2017; Burniske and White, 2017). Burniske and White (2017) note:

> As of December 30, 2016, Bitcoin's average daily liquidity for the trailing three months was more than three-fold the SPDR Gold Shares ETF (GLD) and nearly ten times that of the Vanguard REIT ETF (VNQ).

The Bitcoin trading volume increased to over US$30bn at the end of 2017 and, based on trend analysis, is expected to increase in the future (CoinGecko, 2017d; Wilmoth, 2017).

Bitcoins can also be obtained through mining, allowing another opportunity for investment (Franco, 2015; Antonopoulos, 2017). Mining refers to the process where computing power is devoted to performing cryptographic hash functions with the ultimate purpose of adding blocks of transaction to the blockchain (Franco, 2015; Antonopoulos, 2017). Adding blocks to the blockchain is a critical process and for miners are currently awarded 12.5 Bitcoins and any transaction fees on that block for successfully solving a hash function (Franco, 2015; Antonopoulos, 2017; Ammous, 2018). This principle of using computing power to add blocks to the blockchain is also known as proof-of-work (Franco, 2015; Antonopoulos, 2017; Ammous, 2018). It is worth noting, however, that due to the entrance of large institutional miners into the market, it has become unfeasible and unprofitable for individuals (or small market players) to mine Bitcoins (Beigel, 2017; Hebblethwaite, 2018).

Leveraging off the peer-to-peer nature of Bitcoin, transactions between holders of the Bitcoin also offer opportunities for investment and trading (Chuen, 2015). Opportunities for more passive Bitcoin investment exist where contributions made to funds are used to purchase underlying cryptocurrencies in a determined ratio (Crypto20, 2017; The Token Fund, 2017). The Grayscale (2017) Bitcoin Investment Trust offers opportunities to trade off the market movements in the Bitcoin indirectly. Further to this, the CME Group has introduced Bitcoin futures (Cheng, 2017), enhancing liquidity and lending credence to the Bitcoin representing a new asset class.

Exchanges fulfil another role in that they provide data regarding the price of the Bitcoin (Chuen, 2015). It is interesting to note that the Bitcoin does not trade at the same price across exchanges, showing that there is no purchasing power parity (Brandvold *et al.*, 2015; Chuen, 2015). Further consideration of this is, however, outside the scope of this paper.

Multiple sources exist from which data regarding, *inter alia*, the price, number of transactions and mining statistics of the Bitcoin can be obtained (Bitcoincharts, 2017; CoinDesk, 2017; Poloniex, 2017; Quandl, 2017; Tradeblock, 2017). These data can be used for evaluating risk assessment and investment decisions.

The market capitalisation, at the time of writing, is approximately US$112bn for the Bitcoin (CoinMarketCap, 2018). With the presence of multiple liquidity-providing exchanges, it is evident that there is a large enough market capitalisation to absorb a material portion of investment.

3.2 Politico-economic features

Bitcoin is not backed by any tangible assets like gold or any other precious minerals (Chuen, 2015; Franco, 2015; Hong *et al.*, 2017). It is said that, as a result, there is no intrinsic value (Chuen, 2015; Franco, 2015; Hong *et al.*, 2017). Rather, the basis of value stems from the potential utility and use cases of the digital and consensus-based Bitcoin (Burniske and Tatar, 2017; Burniske and White, 2017; Hileman and Rauchs, 2017; Ammous, 2018). Indeed, speculation on future potential further provides a basis (as opposed to store) of value (Burniske and Tatar, 2017).

The Bitcoin is also unique in that it is not governed by any central authority but is, on the other hand, subject to control by the computer nodes in the network (Nakamoto, 2008; Chuen, 2015; Franco, 2015; Emery, 2016). This is why the Bitcoin is sometimes referred to as being decentralised (Nakamoto, 2008; Chuen, 2015; Franco, 2015; Emery, 2016). The Bitcoin is also heavily influenced by the open-source nature of the underlying software of the protocols (Burniske and Tatar, 2017). This grants control to the developers of the cryptocurrency, the miners and the companies who interface with the Bitcoin (influencing the adoption) (Burniske and Tatar, 2017).

The users of the cryptocurrency are also influential in that they provide feedback to the developers and have the ability to control the success of the Bitcoin through adoption (Burniske and Tatar, 2017). Regulators have had little input to date but have become more active in the cryptocurrency space (Peters *et al.*, 2015; Burniske and Tatar, 2017). There is no consensus among regulators as to the nature of the Bitcoin, for example, in the USA, it is treated as property (Internal Revenue Service, 2014), while in Japan, it is characterised as legal tender (Keirns, 2017).

As a result, the decentralised nature of the Bitcoin is emphasised. While this decentralisation may enhance the risk of the Bitcoin as there is no recourse (Ammous, 2018), it is a key distinguishing factor when compared to traditional fiat currencies.

Further to this decentralisation, the supply of Bitcoins is limited to 21 million (Chuen, 2015; Narayanan *et al.*, 2016; Ammous, 2018). These facts allow for it to move independently of traditional macroeconomic variables such as fiscal and economic policies enacted by centralised governments (Böhme *et al.*, 2015; Burniske and White, 2017). It also allows for value to be generated through scarcity (CoinDesk, 2016; Putnam and Norland, 2017; Ammous, 2018). One can note here that the underlying technology of the Bitcoin allows for a fork or branch to occur, where there is a split-off from Bitcoin (Horizon Kinetics, 2017; Falcon Private Bank, 2018) which can circumvent the limited supply. This is how Bitcoin Cash came into being (Horizon Kinetics, 2017; Falcon Private Bank, 2018) and it is noted for the purposes of this paper that any such forks would give rise to a new cryptocurrency, leaving the limited supply of the Bitcoin itself unaffected. This supply profile of the Bitcoin can be contrasted to equities and bonds which are controlled by the issuers (Burniske and Tatar, 2017); this further emphasises the unique profile of the Bitcoin.

The use cases of the Bitcoin are varied and, given the open-source nature of the underlying software, evolution is expected (Burniske and Tatar, 2017). Hileman and Rauchs (2017) note four major categories of use cases for the Bitcoin:

(1) speculative digital assets or investments;

(2) mediums of exchange;

(3) payment rails; and

(4) non-monetary use cases.

It has been noted that the most common use case for the Bitcoin has been as an investment (Hileman and Rauchs, 2017). This has, however, begun to change with Bitcoin now finding a balance between trading and transacting (Burniske and White, 2017). This indicates that when people use Bitcoin instead of traditional currencies, they are more likely to use it to transmit value for goods and services, as opposed to using it speculatively (Burniske and White, 2017).

The Bitcoin functions as a medium of exchange (CoinDesk, 2016; Burniske and Tatar, 2017). This is evident from the number of merchants who accept payment in Bitcoin, which, while still small compared to traditional fiat currencies, is increasing (Chokun, 2017; Hileman and Rauchs, 2017). The Bitcoin is also used as a payment rail, namely, to make fast and cheap cross-border payments (Chokun, 2017; Hileman and Rauchs, 2017). In a non-monetary context, metadata can be embedded in Bitcoin transactions, allowing for other information such as time stamps, asset ownership and notarial data to be securely stored in the Bitcoin blockchain (Bartoletti and Pompianu, 2017; Hileman and Rauchs, 2017).

From the profile noted above, it is clear that no other assets or combination of other assets share the qualities of the Bitcoin. Shares, bonds, precious metals and other asset classes are not decentralised, do not derive most of their value from application potential, cannot be used as global payment rails and cannot store metadata as a non-monetary use (Bartoletti and Pompianu, 2017; Burniske and White, 2017; Hileman and Rauchs, 2017). In consequence, the profile of Bitcoin cannot be mimicked by other assets, supporting the argument for the Bitcoin representing a separate asset class.

3.3 Correlation of returns

It is noted that assets within an asset class must be closely correlated (Oberhofer, 2001). A correlation between Bitcoin and Ethereum (as the second-largest cryptocurrency by market capitalisation) is performed. This may indicate that they may form part of the same asset class, but a further discussion of this is outside the scope of this research. The correlation is used to explain further the Bitcoin correlations. Additionally, the asset class itself should not be closely correlated to other assets and other asset classes (Oberhofer, 2001; Mongars and

Marchal-Dombrat, 2006; Burniske and White, 2017). Correlations between the Bitcoin and the following other assets are carried out using various indices as proxies for the asset classes. The use of these global indices is consistent with prior studies (Eisl *et al.*, 2015; Carpenter, 2016; Burniske and White, 2017; Krause and Pham, 2017). South African indices are used to provide a developing country perspective to the research. The nature and jurisdiction of these indices and resources are detailed in Table II.

Price data are obtained from INET BFA for the indices, except for the global bond indices and the real estate index that are obtained from the S&P Dow Jones Indices (2018a, 2018b, 2018c). CoinGecko (2017a, 2017b) was used to obtain the Bitcoin and Ethereum data. The daily returns for each asset class have been subsequently calculated using natural logs (Clenow, 2012, p. 4-1; Burniske and Tatar, 2017). These daily returns were then used to determine the correlation coefficients between pairs of assets. The correlations were calculated for each calendar year from 2014 to 2017. Additionally, a four-year correlation is determined. Ethereum only has 2 years of viable date due to the fact that Ethereum is relatively new. The Ethereum Homestead "production-ready" platform needed for consumer adoption was only released in March 2016 (Coindesk, 2016).

Table III depicts the correlation coefficients between Bitcoin, Ethereum and the South African indices, the global indices and resources, including the US$/ZAR currency pair.

Figure 1 provides a graphical representation of the Bitcoin correlation coefficients for 2014 to 2017 per Table III. Figure 2 presents a chart depicting the four-year Bitcoin correlation coefficients to the other 17 asset classes per Table III.

In 2014, most of the Bitcoin correlations were in the single digits, except for the ALSI (−0.10) and the Nikkei 225 (−0.11). The ALSI and the Nikkei 225 were the largest correlations, but, they themselves were weak. Of the 16 correlations to the Bitcoin in 2014, 13 are negative. This shows that in 2014, the Bitcoin could be used to eliminate a fair amount of risk, due to the movements of the Bitcoin being opposite to the other asset classes.

Interestingly, in 2015, most of the correlations to the Bitcoin are now positive (12 out of 16 correlations). Double-digit correlations include correlations to the JSE Top 40 (0.17), the JSE ALSI (0.16), the FTSE 100 (0.13) and the US4/ZAR currency pair (0.12). These are all positive, indicating that the Bitcoin is becoming more correlated with other asset classes. This, perhaps, indicates a maturation of the Bitcoin ecosystem, but further discussion of this is outside the scope of this paper.

In 2016, Ethereum data are introduced and its correlation to Bitcoin is the highest at 0.22. The only other asset class with a large correlation is the Nikkei 225 (−0.16). All other correlations are low. Interestingly, from 2015, it appears that the Bitcoin has moved away from the other asset classes because 10 out of 17 of the correlations are now negative.

In the year of 2017, nine correlations to the Bitcoin are negative with eight correlations as positive. Ethereum still has the largest correlation to the Bitcoin at 0.37, up from 0.22 in 2016. Other than Ethereum, all other correlations are in the single digits and are close to zero. Following the trend from 2016, the Bitcoin is becoming less and less correlated with other asset classes.

Looking at the 4 years from 2014 to 2017, 10 out of the 17 correlations are positive and 7 correlations to the Bitcoin are negative. All the correlations are close to zero, with the exception of Ethereum. It must be noted that the correlation between Bitcoin and Ethereum is 0.30 over the 4-year period. This evidences a moderately strong relationship that could indicate that these two cryptocurrencies belong to the same asset class, but further research is needed in this area as a detailed analysis of Ethereum is outside the scope of this paper.

Table II. Nature and jurisdiction of indices and resources

Jurisdiction	Bonds	Currencies	Equity	Real estate	Resources	Cryptocurrency
South Africa	ALBI (All Bond Index)		JSE ALSI (All Share Index) JSE Top 40	SA Real Estate (Listed Property)		
Japan			Nikkei 225			
USA		USD/ZAR Currency Pair	S&P 500 Nasdaq Composite			
UK			Dow 30 FTSE 100			
Global	S&P Global Developed Sovereign Bond Index S&P International Corporate Bond Index			Dow Jones Global Select Real Estate Securities Index	Gold Platinum Oil	Ethereum

Source: Author's construction

Table III. Correlation coefficients of the bitcoin

Other asset classes	2014	2015	Bitcoin 2016	2017	4-year
Ethereum – only 2016 and 2017	N/A	N/A	0.22	0.37	0.30
ALBI (All Bond Index)	−0.08	−0.07	−0.05	−0.04	−0.05
S&P Global Developed Sovereign Bond	0.00	−0.07	0.07	0.09	0.01
S&P International Corporate Bond	−0.05	−0.04	−0.08	0.09	−0.01
SA Real Estate	−0.07	0.01	0.01	−0.02	−0.01
Dow Jones Global Select Real Estate Securities	−0.06	−0.01	−0.08	0.04	−0.02
JSE ALSI	−0.10	0.16	−0.05	−0.03	0.01
JSE Top 40	−0.09	0.17	−0.05	−0.02	0.01
S&P 500	−0.01	0.04	−0.02	0.02	0.01
Nasdaq Composite	0.01	0.03	0.01	0.05	0.02
FTSE 100	−0.08	0.13	−0.03	0.00	0.02
Dow 30	−0.02	0.05	−0.01	−0.01	0.01
Nikkei 225	−0.11	0.02	−0.16	0.00	−0.05
Oil	−0.08	0.00	0.03	−0.02	0.00
Gold	−0.09	0.00	0.06	−0.05	−0.02
Platinum	−0.06	0.03	0.02	−0.04	−0.01
US$/ZAR	0.09	0.12	−0.02	−0.02	0.03

Source: Author’s construction

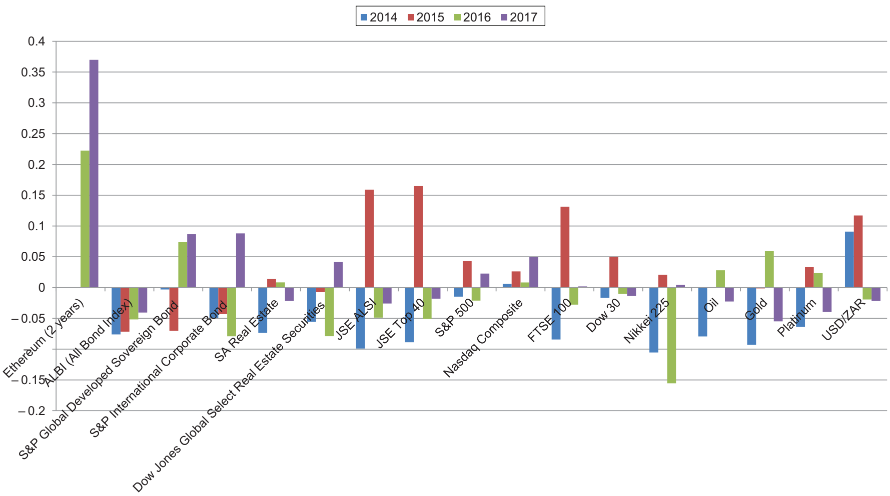
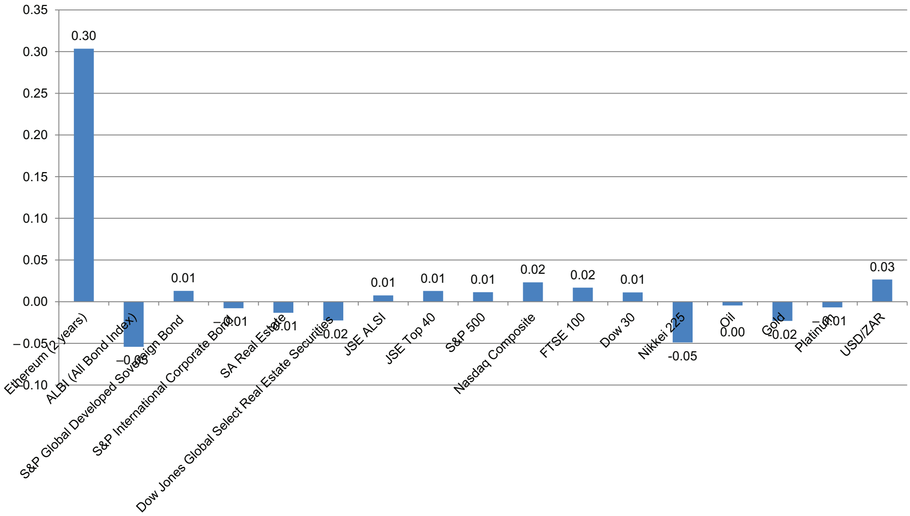


Figure 1. Bitcoin correlation coefficients – 2014 to 2017 coefficients

Source: Author's construction

Overall, the data per Table III indicate that the Bitcoin does not bear a strong or even moderate correlation to any other asset class, other than Ethereum. Most of the correlation coefficients are close to zero. This provides evidence of the fact that significant portfolio diversification can be achieved through investing in Bitcoin. Another observation is that the Bitcoin seemed to be moving toward behaving as the other asset classes (2014 to 2015), but then lost correlation into 2017, emphasising its distinct nature.



Source: Author's construction

Figure 2. Bitcoin correlation coefficients – 4-year coefficients

While the low correlation coefficients are more pronounced than those in prior studies (Burniske and White, 2017; Kevin, 2017), the conclusion remains the same: that Bitcoin appears to represent a separate asset class.

Between the developed country indices and the South African indices, it is noted that there is no significant difference in the correlations to the Bitcoin. This provides evidence that, for the purposes of portfolio diversification and risk mitigation, distinguishing among developed versus developing county indices is of less importance.

3.4 Risk-reward profile

The Bitcoin has experienced significant price volatility, with this volatility being the highest among other asset classes (Burniske and White, 2017; CoinGecko, 2017c). This volatility appears to invalidate the Bitcoin from being a stable store of value, but this is not necessarily a requirement for an asset class as Greer (1997) notes that there are different "Superclasses" of assets. From the perspective of absolute value returns, the Bitcoin has provided a 2017 year-to-date price return of 1,387 per cent (CoinGecko, 2017d). This level of absolute value return exceeds the return on any other asset classes (Burniske and Tatar, 2017; Burniske and White, 2017). For a robust analysis of risk and reward, however, it is not sufficient to consider them in isolation, so, we consider the Sharpe ratio.

The Sharpe ratio provides a risk-adjusted measure of return (Sharpe, 1966; Burniske and White, 2017). Using the Sharpe ratio, assets can be compared and the greater the Sharpe ratio, the greater the compensation to investors for the accepted risk (Sharpe, 1966; Burniske and White, 2017).

Some analysis must be conducted into choosing the relevant risk-free rate. The currency of the prices used in the analysis must determine the risk-free rate (Damodaran, 2008). PwC (2017) noted that the most common risk-free rate in East, Southern and West Africa is the local currency bond yield. In Australia, the yield on the 10-year local currency government bond is used as the risk-free rate (KPMG, 2017). These cases support the use of a local currency risk-free rate. Treasury rates are commonly used as the risk-free rate for respective currencies (Du and Schreger, 2013).

Jagannathan *et al.* (2016) used the US Treasury bond rate as their risk-free rate and noted that it must match the time horizon of the project. As there is no time horizon for the purposes of the Sharpe ratio, a 30-year US Treasury rate of 2.85 per cent on 1 November 2017 is selected for the US$-denominated indices (USA Department of the Treasury, 2017). For the South African Rand denominated indices, the R186 government bond is selected and the rate is 9.01 per cent on 1 November 2017 (South African Reserve Bank, 2017). The selection of the R186 is consistent with the PwC (2017) study.

Table IV presents the daily Sharpe ratio calculated for each asset class using the same data and for the same period as used in Section 3.3. The daily Sharpe ratio is annualised using the days excluding weekends for each year: 261 days (2014), 260 days (2015), 261 days (2016) and 260 days (2017).

Figure 3 provides a graphical representation of the Sharpe ratios for the 18 asset classes, including the Bitcoin, for 2014 to 2017 per Table IV. Figure 4 presents a chart depicting the 4-year Sharpe ratios of the 18 asset classes per Table IV.

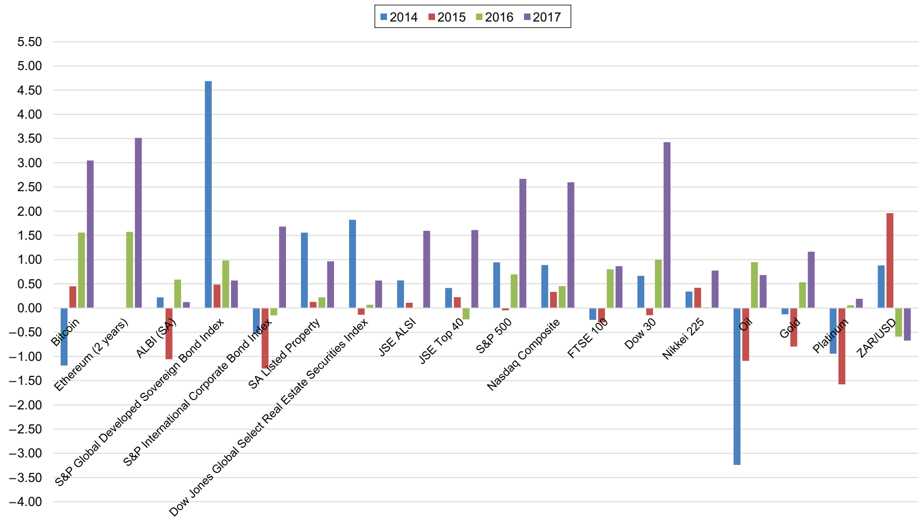
Returns in 2014 on the Bitcoin were negative which resulted in a negative Sharpe ratio (−1.19). This showed that investors were subject to high levels of risk with little to no compensation. Individuals involved in the Bitcoin in 2014 were typically early adopters of the Bitcoin (Wolfson, 2015) which could indicate that they had a high risk threshold.

In 2015, the Sharpe ratio for the Bitcoin amounted to 0.45. There was a shift from a negative ratio, thereby, indicating that the returns started to exceed the risk-free rate. Only the S&P Global Developed Sovereign Bond Index (0.48) and the ZAR/US4 currency pair (1.96) had higher Sharpe ratios. This indicated a shift in the risk-reward profile of the Bitcoin where reward was now outweighing the risk, resulting in increasing adoption (Dodd, 2017).

Asset classes	2014	2015	2016	2017	4-year
Bitcoin	−1.19	0.45	1.56	3.05	2.07
Ethereum (2 years)	N/A	N/A	1.57	3.51	5.02
ALBI (SA)	0.22	−1.06	0.59	0.12	−0.25
S&P Global Developed Sovereign Bond Index	4.69	0.48	0.98	0.57	2.65
S&P International Corporate Bond Index	−0.52	−1.25	−0.15	1.68	−0.24
SA Listed Property	1.56	0.13	0.22	0.96	1.12
Dow Jones Global Select Real Estate Securities Index	1.82	−0.14	0.07	0.57	0.81
JSE ALSI	0.57	0.11	0.00	1.59	0.87
JSE Top 40	0.41	0.22	−0.23	1.61	0.75
S&P 500	0.94	−0.05	0.69	2.67	1.53
Nasdaq Composite	0.89	0.33	0.45	2.60	1.75
FTSE 100	−0.24	−0.30	0.80	0.87	0.47
Dow 30	0.66	−0.15	1.00	3.42	1.70
Nikkei 225	0.34	0.42	0.02	0.77	0.74
Oil	−3.24	−1.09	0.95	0.68	−0.76
Gold	−0.13	−0.80	0.53	1.16	0.28
Platinum	−0.94	−1.58	0.06	0.19	−1.07
ZAR/US$	0.88	1.96	−0.59	−0.67	0.53

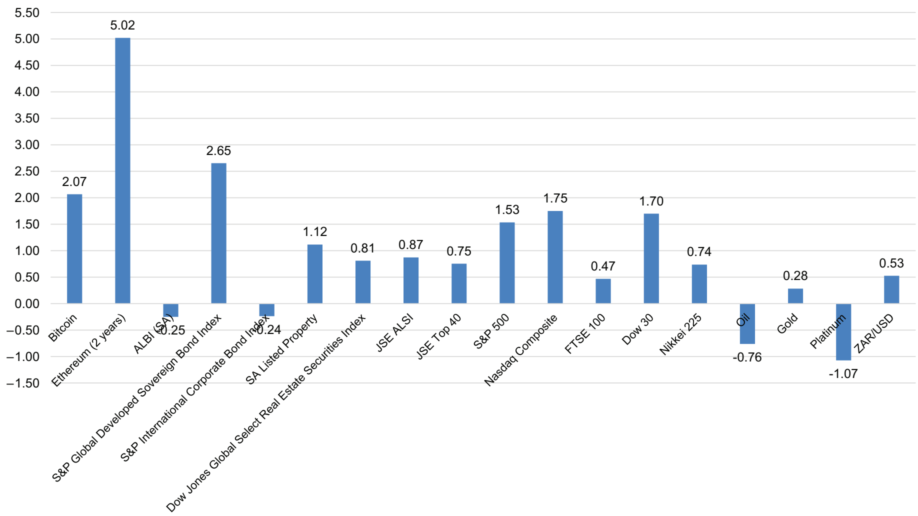
Source: Author's construction

Table IV.
Sharpe ratios



Source: Author's construction

Figure 3.
Sharpe ratios for asset classes – 2014 to 2017 ratios



Source: Author's construction

Figure 4.
Sharpe ratios for asset classes – 4-year ratios

In 2016, only Ethereum (1.57) provided slightly higher returns for its risk than Bitcoin (1.56). The value of the Sharpe ratio increased from 2015, further reinforcing the positive risk-reward profile of the Bitcoin.

The Sharp Ratio of the Bitcoin in 2017 amounted to 3.05, which is an increase from 2016. Only Ethereum (3.51) and the Dow 30 (3.42) exhibited higher risk-adjusted returns than the

Bitcoin, resulting in Bitcoin providing some of the highest rewards for its risk compared to the other asset classes.

For the 4-year Sharpe ratio, the Bitcoin ratio is 2.07. This is only outperformed by Ethereum at 5.02 and the S&P Global Developed Sovereign Bond Index at 2.65. The Bitcoin's risk and reward profile far exceeds the other 17 classes. It is clear that investors are compensated for investing in the high levels of volatility (Burniske and White, 2017; CoinGecko, 2017c) which the Bitcoin experiences.

This research reinforces the overall risk-reward profile findings of the Bitcoin by Burniske and White (2017).

4. Discussion and conclusion

The Bitcoin, among many cryptocurrencies, is continuing to grow in popularity (European Central Bank, 2012, 2015; He *et al.*, 2016; Hileman and Rauchs, 2017).

The purpose of this research is to determine whether the Bitcoin represents a unique and distinct asset class. Such research is necessary to provide insight into the Bitcoin for investment and diversification decisions by individuals and firms alike.

Using the literature on what represents an asset class, key criteria are distilled (Section 2.1). These criteria are explored in further detail in Section 2.2. The key criteria were then used to analyse the Bitcoin in Section 3.

The analysis reveals that the Bitcoin presents unique attributes. The Bitcoin has numerous opportunities for investment and sufficient market capitalisation (CoinMarketCap, 2018), meeting the requirements of investability (Section 3.1). From direct investment (Crypto20, 2017; Grayscale, 2017; The Token Fund, 2017) and mining (Chuen, 2015) to passive investment (Cheng, 2017) and the plethora of exchanges available (Buy Bitcoin Worldwide, 2017; van Vuuren, 2017), the Bitcoin is sufficiently represented in the financial markets.

The politico-economic profile is dissimilar to other asset classes due to the open-source and decentralised nature of the Bitcoin (Section 3.2). The Bitcoin has unique use cases and can store metadata which cannot be replicated by other asset classes (Bartoletti and Pompianu, 2017; Hileman and Rauchs, 2017). Additionally, there is little or no correlation with other asset classes (in both developed and developing countries), showing that considerable risk reduction is possible through investing in the Bitcoin (Section 3.3).

Further, the Bitcoin provides greater risk adjusted returns than do many other asset classes (Section 3.4). This is shown through the high Sharpe ratio of the Bitcoin from 2014 to 2017 and the 4-year ratio, as compared to the other asset classes.

The implications of this research are myriad. One of the most important determinations in creating an investment portfolio is asset allocation (Vanguard, 2015), and this research provides evidence that the Bitcoin represents a unique alternative asset that can be used to diversify risk and enhance returns. An avenue for further research involves determining if other cryptocurrencies, such as Ethereum, are a distinct asset class or if they can be classified as an asset class together with Bitcoin.

In the rapidly changing economic, developmental and social environment of cryptocurrencies, it is vital that further research into finance paradigms be undertaken. The technology behind cryptocurrencies and the Bitcoin, in particular, is leading to the development of entirely new industries through smart contracts and other blockchain-based applications (Burniske and Tatar, 2017; Burniske and White, 2017). This research adds to the limited body of finance research into the Bitcoin and provides a valuable guide to developing and developed country investors for understanding the Bitcoin as a discrete alternative asset and a new asset class.

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