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EFFECT OF BITCOIN TRADING ON THE GLOBAL ECONOMY

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ABSTRACT

Popularity of the cryptocurrency concept in the global financial community has surged in recent years. Since its introduction and application over a decade ago, the cryptocurrency industry has been inundated with different forms, including bitcoin. Bitcoin and altcoins which come in the forms of coin and token have gained tremendous popularity among committed investors and backers who relish the art of trading in cryptocurrencies. Bitcoin, was introduced with fundamental objectives. Many investment analysts were of the firm belief bitcoin is a useful financial tool in the investment world. This notwithstanding, it is fraught with challenges; bitcoin traders in the cryptocurrency industry are not sparred of risk inherent in technological challenges which negatively impact on smooth and successful investments in the virtual financial markets. The purpose of this research was to assess how bitcoin trading activities impact on the performance of all cryptocurrencies in the global digital financial markets; and the impact on the global economy. The quantitative approach to scientific inquiry was adapted and used in the current research. Specifically, a cross-sectional design, an example of survey design, formed the basis for the research. Data required for the conduct of the study were obtained mainly from secondary sources. These included text books, peer-reviewed articles published in journals, newspaper publications, and digital currency markets. Other sources were Google Search Engine including statista.com, ycharts.com, crowdfundinsider.com, finance.yahoo.com; and electronic databases of the World Bank, IMF and OECD, among other significant sources. Respective data on quarterly circulated bitcoins, quarterly bitcoin prices and quarterly market capitalisation values for bitcoin from 2012 through 2020; annual market capitalisation values for all cryptocurrencies from 2013 through 2020; and annual global GDP data from 2012 through 2020 were used in the study. Contrary to expectations of Nay-Sayers, the research revealed exponential development of bitcoin in the global virtual financial space; its major role in asserting the influence of cryptocurrencies on the mainstream global financial system; and policy standards developed by FATF to regulate operations of virtual financial exchanges at the global level. Two-thirds of individuals without bank accounts have smartphones. Virtual currency operators perceived this as an opportunity to sell finance to the unbanked smartphone-users' population. Findings from the research revealed positive and significant relationship between bitcoin market cap values and market cap values for all cryptocurrencies (coefficient value = 1.501991851; $p = 0.000$, $p < 0.05$); and positive, but non-significant relationship between bitcoin market cap values and global GDP values (coefficient value = 43.11477029; $p = 0.1718$, $p > 0.05$). Bitcoin market cap values accounted for about 92.01% of the variation in market capitalisation values for all cryptocurrencies; and about 24.87% of the variation in global GDP values during the period. The study recommended the need for individual economies to review their respective perception of and stance on bitcoin and altcoins; and to identify ways in which they could effectively incorporate cryptocurrencies' trading and related activities into their respective financial sub-sector laws and regulations. Economies that are yet to commit their membership to FATF were entreated to do so to assure uniformity in global regulatory standards for digital currencies to facilitate their universal acceptance. Economies that fail to appreciate and embrace bitcoin and altcoins for implementation could be likened to individuals or groups with strong preference for desktop computers; and not willing to change to use of laptops and other improved versions of the device. Countries must strive to contribute meaningfully to the progress needed in the global financial space through improved ***financial digital transformation***.

Key words: *bitcoin, bitcoin exchange, cryptocurrency, types of cryptocurrency, digital exchange market, and virtual currency market.*

1.0 INTRODUCTION

Popularity of the cryptocurrency concept in the global financial community has surged in recent years. Patrons of the novel digital currencies have increased in recent periods. The term cryptocurrency comprises two significant words. These include “crypto” and “currency.” The term crypto connotes “hidden” while currency could be described as a synonym for “money.” Thus, cryptocurrency could be explained fundamentally to mean a hidden currency or money (Ashley, 2018). The term crypto is described by Reiff (2020) as complicated cryptography which facilitates creation and processing of virtual currencies and their related transactions across decentralised systems. Further, the author defined cryptocurrency to include a monetary instrument that is digital or virtual in nature; takes the form of a coin or token; and characterised largely by intangible usage or application in the financial world, with “snippets” of use in the areas of credit cards and other projects. The European Business Review (2020) believed the term crypto in the name cryptocurrency is indicative of how cryptography ensures the safety of digital financial data; and protects same from hackers. Many cryptocurrencies rely on blockchain technology and platforms for their circulation and usage. Kirk (2016) defined blockchain as a cryptographic ledger in which virtual currency transactions are verified; the transactions are verified by computers contributing data to the blockchain.

Since its introduction and application over a decade ago, the cryptocurrency industry has been inundated with different forms. Reiff (2020) found as of January 2020, there were over two thousand different forms of cryptocurrencies in circulation globally. These cryptocurrencies which come in the forms of coin and token have gained tremendous popularity among committed investors and backers who relish the art of trading in cryptocurrencies across the globe. The level of evolution witnessed in the global industrial community in recent years is equally witnessed in the global cryptocurrency industry; new tokens are invented almost “every day.” Thus, the global financial community may wake up the next day to witness the invention and introduction of greater token or coin than the existing ones. As Reiff (2020) noted, the list of cryptocurrency types in circulation may not be exhaustive. As a result, few were considered for discussion in the current research. Examples of cryptocurrencies in circulation and considered for discussion in this section included litecoin, bitcoin cash or BCH, tether, libra or LIBRA, EOS, monero or XMR, ethereum or ETH, bitcoin SV or BSV, binance coin or BNB, ripple or XRP, and bitcoin or BTC (Kirk, 2016; The European Business Review, 2020).

The ten preceding cryptocurrencies listed above were invented and introduced to the global financial market after bitcoin (the eleventh example listed above). Collectively, all cryptocurrencies modelled after bitcoin are called ***altcoins***. As the name implies these are alternative coins, and have the tendency to be introduced as improved or modified versions of bitcoin (Reiff, 2020). Altcoins were invented to serve as alternatives to bitcoin not only in the cryptocurrency industry, but also in the global financial market; and in the global business environment. Altcoins were introduced to address challenges inherent in the functionality of the original cryptocurrency, bitcoin.

In 2011, litecoin was launched and introduced to the cryptocurrency industry; and to the global business community in general. Some financial analysts described litecoin as one of the early cryptocurrencies to be invented after bitcoin; and if bitcoin were a gold, litecoin were its silver. Invention of litecoin was credited to Charlie Lee, former Google engineer, and graduate of the Massachusetts Institute of Technology (MIT) in the United States of America (USA). Litecoin operates on an open-source global payment network with no central authority control; it employs “scrypt” as a proof of work; and can be decoded with the assistance of computer power units (CPUs) of consumer grade. Litecoin is similar to bitcoin in many facets. However, the former has superior attributes such as faster block generation rate; and faster transaction confirmation time. The acceptance of litecoin as a medium of transaction among merchants is on the ascendancy in recent

years. The foregoing attribute adds up to its growing popularity among programmers and systems developers (Reiff, 2020). Statistics released by Reiff (2020) indicated the respective per-token value and market capitalisation value for litecoin as at 8th January, 2020 were US$46.92 and US$3 billion. These values implied litecoin was the sixth-largest cryptocurrency globally during the period.

In August 2017, ***bitcoin cash or BCH*** was introduced to the global financial market as one of the legion of cryptocurrencies to be introduced after bitcoin. The introduction of bitcoin cash as a separate digital currency was borne out of a split, the by-product of protracted debates and disagreement between developers and miners. The central argument leading to the invention of bitcoin cash related to the issue of scalability; bitcoin cash needed a block size of eight megabytes while the Bitcoin network maintains a strict block size limit of one megabyte. Reiff (2020) described BCH as one of the earliest and most successful hard forks of the novel bitcoin. Generally, in the world of cryptocurrencies, arguments and debates between miners and developers result in a fork. This fork or stalemate could result in the split of the affected digital currency, a basis for the "birth" of bitcoin cash. Performance of BCH in the digital financial market is quite encouraging. For instance, as at 8th January, 2020, the respective market capitalisation and per-token values for bitcoin cash were US$4.4 billion and US$240.80. Due to the foregoing, bitcoin cash was believed to hold a unique role in the history of altcoins; its per-token value (US$240.80) was the highest during the period.

Volatilities in the global financial markets and business environment in general made it imperative for developers and miners to consider the creation of coins that would ensure stability by pegging value of the newly-created coins to a currency or any other identified external reference point. Consequently, ***tether*** was introduced as one of a group of stable coins to iron-out price differentials and fluctuations, so as to attract conservative investors and users who hitherto, would have stayed away from the virtual financial markets. The effectiveness of tether in the cryptocurrency industry is evident in its general performance: as at 8th January, 2020, tether had a value per token of US$1.00 and market capitalisation value of US$4.6 billion. The latter value was superior to the respective market capitalisation values recorded by bitcoin cash (US$4.4 billion) and litecoin (US$3 billion) during the period. Tether was launched in 2014 as a blockchain-enabled platform, so it could facilitate digital utilisation of sanctioned currencies. Practically, tether allows investors to use blockchain network and related technologies in the transaction of traditional currencies while reducing complexities and volatilities often characteristic of digital currency trading to the barest minimum. As at 16th December, 2020, tether's market capitalisation value had more than quadrupled (about 4.3 times) to US$19.794 billion while its value per token remained at US$1.00 (Coin Market Cap, 2020).

In early to mid-year 2018, there were speculations in the global cryptocurrency industry about the development and introduction of a new digital currency by Facebook, Incorporated, a leading social media organisation across the globe. On 18th June, 2019, the prior speculations were confirmed; Facebook released a white paper to formally announce and confirm its resolve to create a new digital coin called ***libra***. However, as of January 2020, Facebook was yet to launch its new digital currency. This notwithstanding, tentative date to launch the libra was 2020. Libra is expected to attract patrons from within and outside the cryptocurrency industry. It is worth-re-emphasising the formal announcement by Facebook confirmed earlier speculations about the possibility of Facebook launching its version of the digital coin. This announcement increased chances of the new digital currency performing very well, given the global reach of Facebook; and volumes of transactions and exchanges across its platform. Launch of libra was delayed partly due to Facebook's resolve to first address regulatory challenges to ease operations. The functionality of libra would be supervised by Calibra, one of Facebook's subsidiaries in-charge of financial services.

A report by the Financial Times (as cited in Entrepreneur Staff, 2020b) noted postponement of the launch of libra to early 2021. Libra is expected to be a dollar-backed digital currency; and its launch would be in a more limited format than earlier predicted. That is, the launch of libra would not include a combination of several currencies owing to pressures from regulatory bodies and banks. Issuance of libra would be subject to approval of the financial regulator in Switzerland, the Financial Market Supervisory Authority (FINMA), which is in charge of banking supervision, financial markets and insurance firms, among others. Barring any future changes, libra is expected to be launched by the Geneva-based Libra Association. After its launch, libra would compete with digital currencies such as trueUSD (TUSD), tether (USDT) or USD coin (USDC). These tokens are linked to the American dollar and described as relatively stable virtual currencies. The stability makes them suitable for payments or cash transfers.

EOS is a digital coin that has made valuable contributions to altcoins and the cryptocurrency industry in general. This digital currency was invented by Dan Lorimer, one of the pioneers in the cryptocurrency industry. He is noted for establishing the Bitshares exchange and Steemit, a blockchain-based social media platform. The initial coin offering (ICO) of EOS was on record as one of the longest and most profitable in the annals of cryptocurrency history. The ICO of EOS fetched about US$4 billion through crowd-sourcing efforts which lasted over a year. As at 8th January, 2020, EOS had per-token value of US$2.85 and market capitalisation value of US$2.7 billion. EOS' per-token value (US$2.85) was higher than the value recorded by tether (US$1), albeit the latter had a superior market capitalisation value (US$4.6 billion) during the period. Generally, traders of EOS are offered a delegated proof-of-stake mechanism. This mechanism is expected to provide scalability beyond offerings by competitors while its complex systems are intended to present a network that is more decentralised, democratic and user-friendly than those operated by its competitors in the cryptocurrency industry. Similar to the networks of other altcoins, EOS has a platform which allows developers to build decentralised applications. EOS lacks the mining mechanism to generate tokens. As a result, it is described by experts in the cryptocurrency industry as revolutionary (Reiff, 2020).

A digital currency which employs a special technique known as *ring signatures* to assure complete privacy of traders is ***monero or XMR***. Launched in April 2014, this currency is described as private, secure and untraceable. It was launched with strong emphasis on scalability and decentralisation. Development of monero was completely community-driven and donation-based. Immediately after its launch in 2014, monero became very attractive to connoisseurs of cryptocurrency and the cryptography community. As at 8th January, 2020 available statistics indicated monero had respective market capitalisation and per-token values of US$994 million and US$57.16. However, increased privacy associated with the monero network has spiked notoriety in its usage for criminal activities globally. The foregoing notwithstanding, some analysts believed monero adds significantly to the pool of digital currency inventions in the cryptocurrency industry (Reiff, 2020).

Ethereum is an altcoin that provides strong protection for its traders and users. Invention of this virtual currency included development of decentralised software platform that allows decentralised applications (DApps) and smart contracts to be built and run. Generally, these software applications are carried out without any interference, fraud, downtime or control from third parties. Ethereum has platform-specific cryptographic token called ***ether*** on which its applications are run. Developers seeking to develop and run applications inside ethereum look for the ether, which navigates like a vehicle on the ethereum platform. Ether was launched in 2015. It has market capitalisation value of US$15.6 billion; and value per token of US$142.54, the second-highest after BCH (US$240.80). Ether's market capitalisation value was the highest among altcoins and the second-highest among

all cryptocurrencies after bitcoin; its market capilisation value was equivalent to one-tenth of bitcoin's value during the period. The pre-launch of ethereum in 2014 had overwhelming response from investors and backers. Ethereum's initiative ushered in the era of initial public offering in the cryptocurrency industry. The functions and benefits of ethereum are multi-faceted; its usefulness in codifying, decentralising, securing and trading in the financial and broader business environment cannot be over-emphasised. In 2016, there was an attack on DAO. This resulted in the split of ethereum into ethereum classic (ETC) and ethereum (ETH) (Reiff, 2020; The European Business Review, 2020).

Bitcoin SV or BSV is another digital coin that was borne out of stalemate or split. Reiff (2020) noted the acronym, "SV," means "Satoshi Vision." Bitcoin SV was derived from a split of bitcoin cash, implying it was created from the original Bitcoin network following debates and arguments between developers and miners in the bitcoin cash community. A planned network upgrade for bitcoin cash in November 2018 culminated in extended debate and factions; and eventual creation of bitcoin SV. An observed common thread in the cryptocurrency industry is the emergence of hard fork (end-result of debates and arguments usually between developers and miners) often leads to splits and creation of new digital currencies. Proponents of bitcoin SV argued its invention has important benefits. First, it would facilitate development of other digital coins to increase stability while allowing for scalability in the cryptocurrency industry. Second, it would increase security of traders while improving on transaction processing times. Finally, bitcoin SV is expected to restore Satoshi Nakamoto's original protocol. Bitcoin SV's value per token as at 8th January, 2020 was US$114.43 while its market capitalisation value during the period was US$2.1 billion. Bitcoin SV had the third-highest per-token value after bitcoin cash (US$240.80) and ethereum (US$142.54) respectively (Reiff, 2020).

In 2017, the Binance cryptocurrency exchange platform was founded; and in January 2020, Binance was described as an exchange that had evolved to become the largest in terms of trade volumes in the virtual currency industry. Official token of Binance exchange is known as the ***binance coin or BNB***. Payments for certain goods and services including travel fees, and others; and payments for transaction fees on the Binance exchange could be made using binance coin. Users of binance coin have the opportunity to trade in multiples of cryptocurrencies on the Binance platform. The respective per-token and market capitalisation values for binance coin as at 8th January, 2020 were US$14.71 and US$2.3 billion (Reiff, 2020).

Creation and launch of ***ripple or XRP*** in 2012 allowed its developers to emerge with a real-time global settlement network useful for low cost, instant, and certain international payments. Ripple is known as the *banker's coin* (The European Business Review, 2020) because it has growing popularity among banks across the globe. Ripple facilitates international banking transactions: it allows banking institutions to settle payments across borders with relative ease; ensures end-to-end transaction transparency; and successful completion of international banking transactions at lower costs. These attributes make ripple very attractive to traditional banking institutions who seek to expedite international payments. Tokens for ripple were mined prior to its launch in 2012, implying there is no "room" for creation of new ripple over time; the existing number of ripples would be rotated in the market through buying, hoarding, and selling over time. This helps to reduce network latency and to minimise use of computing power in the transaction process. Market capitalisation value for ripple as at 8th January, 2020, was US$9.2 billion, making it the third-largest cryptocurrency during the period. Ripple's value per token during the period was US$0.21, one of the lowest in the cryptocurrency industry (Reiff, 2020; The European Business Review, 2020).
Bitcoin remains a pacesetter in the cryptocurrency industry. It was the first digital currency to be created and used in the cryptocurrency industry; and in global financial markets as well as the

global business environment. Reiff (2020), Urquhart (2020) and The European Business Review (2020) described bitcoin as trendsetter and de facto standard for all cryptocurrencies. The presence of bitcoin has encouraged the emergence of myriad of cryptocurrencies in the global financial markets and business environment. Bitcoin's dominance in the cryptocurrency industry in terms of popularity, user base, and market capitalisation, is unequalled. In the conduct of the current research, it was imperative to examine the impact of bitcoin's trade values on global gross domestic product (GDP) values over the period. Detailed explanation on bitcoin which formed the basis for the current research is presented in the following section.

1.1 BACKGROUND OF THE STUDY

In 2008, *Networking P2P Foundation* published a white paper on a novel cryptocurrency to be introduced to the global financial community. The white paper was believed to have been authored by Satoshi Nakamoto. Content of the white paper provided briefs on the new digital currency intended to be released to the financial world in the not-too distant future. On 3rd January, 2009, a new digital coin was created and introduced to the global financial market. This virtual currency is called ***bitcoin***. However, original creator of the bitcoin remains a mystery to the global financial community. The new digital currency, bitcoin, was introduced with fundamental objectives. That is, to introduce a virtual currency that would serve as a medium of payment with universal acceptance, facilitate globalisation of the financial markets at an accelerated pace, remove bottlenecks witnessed in the global financial market; and to facilitate payments for transactions across borders, among others (Anonymous as cited in Ashley, 2018; Urquhart, 2020).

Although the white paper publication on bitcoin identified the author as Satoshi Nakamoto, no name accompanied release of the cryptocurrency on 3rd January, 2009. As a result, financial pundits attributed invention of the bitcoin to Satoshi Nakamoto. Stated in different words, Satoshi Nakamoto is believed to be creator of the original reference of the digital coin and its implementation. Historically and more importantly, Satoshi Nakamoto is recognised as the maiden inventor to have succeeded in addressing the challenges of double-spending, characteristic of digital coins. Earlier debates on development of blockchain databases factored the implementation process of bitcoin into the discussions. The name Satoshi Nakamoto still remains a mirage in the cryptocurrency world. However, some experts argued a pseudonym was substituted for the original name in the creation of the virtual currency (Hodge as cited in Ashley, 2018).

Anonymous (n.d.) and Yellin, Aratari and Pagliery (n.d.) described bitcoin as the first digital coin to experience global decentralisation. Stated differently, bitcoin remains the maiden digital currency with no requirements for middlemen in its transaction processes; it is the maiden digital coin with payment system that does not require sole administrator; and does not require the involvement of central banks. The foregoing affirms the non-requirement of banks in bitcoin transactions. These features underscored the importance of the current research. That is, to examine the activities of bitcoin traders; how those activities affect investments and revenues; and the resultant effect of bitcoin trade values on values for all cryptocurrencies; and on global output (GDP). Further discussion in this section is presented under the following sub-headings: measurement, markets and circulated bitcoins; and bitcoin's historical prices and values.

1.1.1 Measurement, Markets and Circulated Bitcoins

Generally, bitcoin is measured in multiples of a *satoshi*. On 3rd January, 2009, a ledger was created and started for bitcoin. This ledger has a supply limit of twenty-one million (21,000,000) bitcoins.

The algorithm inherent in the Bitcoin network ensures the number of bitcoins in circulation is not in excess of 21 million. Further, the Bitcoin network allows for each bitcoin to be divided into different fractional parts; one bitcoin can have fractional parts up to eight (8) digits. The foregoing implies a bitcoin can be divided into 100,000,000 units (1 ÷ 100,000,000 = 0.00000001). Each unit of bitcoin derived thereof is known as satoshi. The smallest unit in a bitcoin is the *satoshi* (0.00000001 BTC). It is likely for a bitcoin to have a fractional part up to three (3) digits. Such a bitcoin is called a *millibitcoin* (1 ÷ 1,000 = 0.001 BTC) (Anonymous; Yellin et al. as cited in Ashley, 2018). The transfer of bitcoin occurs between 34-character alphanumeric addresses. These alphanumeric addresses appear in the blockchain, but do not reveal the identity of individuals who control the funds (Kirk, 2016; The European Business Review, 2020; Urquhart, 2020).

Several exchange market places were established to expedite trading in the digital coin; and to sustain and consolidate gains from the markets for bitcoin. These exchange markets most of which exist virtually allow traders to purchase and sell bitcoins and other cryptocurrencies, using currencies of different countries. Some of the exchanges that were established early to consolidate gains from bitcoin; and to sustain the virtual currency market in general included Coinbase GDAX, Bitstamp, Coinone, ShapeShift, Changelly, Ripple, Litecoin, Bitfinex, Mt. Gox, Kraken, Bitcoin Suisse, 37coins, Xapo, LocalBitcoins, Dogecoin, Monero, BitGo, Airbitz, WazirX, Zebpay, Unocoin, LakeBTC, BX Thailand, Bitso, bitFlyer, CEX.IO, OKCoin.cn, Korbit, Bithumb, Gatecoin, LiteBit.eu,Cointed, Coinsecure, BitQuick, BitcoinFundi, Wirex, TradeSatoshi, Jubi, CHBTC, TuxEchange, BitBay, BitMarket, BTER, Liqui, Cryptopia, Exmo,BTC100, BitcoinToYou, Mercado Bitcoin, Luno, itBit, Coinfloor, Bitsane, RippleFox, USD X, Allcoin, Cryptomate, Bitcoin Indonesia, LiveCoin, HitBTC, GDAX, Bittrex, and Poloniex, among others (Coinpedia.org as cited in Ashley, 2018; De Best, 2020b). Recency of the virtual currency technology makes it difficult for some retailers to accept payments in bitcoins. Collectively, the foregoing markets are often called *Bitcoin or Virtual Exchanges*. In addition to the online exchanges, automated teller machines (ATMs) have also been identified as a means of trading or buying and selling bitcoins and altcoins (De Best, 2020a & b; Kirk, 2016; The European Business Review, 2020).

BTC China is the leading bitcoin exchange in the People's Republic of China while Mt. Gox exchange dominated the bitcoin market in Japan. In 2018, these two exchanges recorded strong volumes of bitcoin trading at the global level. Other bitcoin exchanges with greater investor participation include Coinbase GDAX, Bitstamp, Blockchain, Bitfinex, Tether, Ethereum, and Litecoin (Ashley, 2018; De Best, 2020a & b). Available data from the website of Blockchain revealed as at October 2013, about 11.9 million bitcoins were in circulation globally through the various virtual financial exchanges. As at 15th January, 2018, the total number of bitcoins in circulation had increased to 16.8 million, representing 80% ((16.8 million ÷ 21 million) x 100% = 0.8 x 100% = 80%) of total bitcoins mined and available for circulation (21 million); and implied the availability of only 4.2 million bitcoins (21 million –16.8 million = 4.2 million) for circulation globally. The outstanding bitcoins (4.2 million) were equivalent to 20% ((4.2 million ÷ 21 million) x 100% = 0.2 x 100% = 20%) of total mined bitcoins during the period.

As at the end of the third quarter of 2020, there were 18.5 million bitcoins in circulation globally. This was about 0.43% increase over the 18.42 million in circulation at the end of the second quarter (De Best, 2020a & b). However, it was very likely the number of bitcoins would not be increased beyond its current threshold of 21 million; Satoshi Nakamoto has not given any indication of further increase in volume of bitcoins.

1.1.2 Bitcoin's Historical Prices and Values

Generally, one observes a relationship between volatilities in the global virtual financial markets and bitcoin value. That is, volatilities in the financial markets tend to have an effect on per-token and market capitalisation values for bitcoin. This explains the evolution of per-token value for bitcoin relative to the American dollar in prior and recent periods. To illustrate, the value per token for bitcoin as at July 2010 was US$0.08. That is, 1BTC to US$0.08. However, earlier in the month of July 2010, the per-token value for bitcoin was US$0.008, implying 900% ((US$0.08 - US$0.008) ÷ US$0.008) x 100% = 900%) surge in price per token over the period. Popularity and prominence of bitcoin among local and international traders in the cryptocurrency industry did not vacillate and wane; they continued to increase in tandem with growing acceptance of the token as a medium of exchange in the international virtual financial markets. The advent of bitcoin culminated in local and international traders heaving a sigh of relief; they believed a medium of exchange that would eliminate increasing and complex regulations in the international financial markets had been invented and introduced (Ashley, 2018).

Growing popularity of bitcoin was met with increase in its per-token value as evidenced between February 2011 and April 2011: 1BTC was traded at US$1.00. The per-token value for bitcoin on 8th July, 2011 was phenomenal; a token of bitcoin was traded at US$31.00. However, the significant hike in price could not be sustained; there was a bubble burst in December 2011 as per-token value for bitcoin plummeted to US$2.00, representing about 93.55% decrease; and rebounded later to trade at 1BTC for US$13.00 (La Monica as cited in Ashley, 2018).

Nonetheless, the financial effervescence of the novel digital currency that is, bitcoin was not impacted negatively by the foregoing challenges related to its per-token and market capitalisation values; the per-token value for bitcoin began to increase in significant folds. In early April 2013, bitcoin's value per token was US$266.00, representing about 1,946.15% increase over the previous price (US$13.00); and in a matter of days, it plunged to US$54.00 per token. However, later in the month of April 2013, the per-token value of bitcoin appreciated to US$150.00; and remained unchanged until June 2013 when it plummeted to US$70.00. At the close of day on 24th October, 2013, the per-token value for bitcoin was US$233.40, implying about 233.43% increase in the value (US$70) recorded in June 2013 (La Monica as cited in Ashley, 2018).

As at 5th August, 2017, bitcoin had a per-token value of over US$3,000.00. This was a significant achievement in the history of bitcoin and the cryptocurrency industry. A week later that is, on 12th August, 2017, the per-token value for bitcoin was over US$4,000.00. By 14th August, 2017, the value per token for bitcoin had surged to US$4,400.00 while the per-token value in September 2017 was US$5,013.91. A token of bitcoin as at 5th March, 2018, was traded at US$11,455.50. This represented significant increase in value per token of over 128.47% ((US$11,455.50 – US$5,013.91) ÷ US$5,013.91) x 100% = 1.28474 x 100% = 128.474%) between September 2017 and March 2018. Data accessed from Ycharts (2020a & b) revealed the closing market value per token for bitcoin on 10th December, 2019 was US$7,199.39 while the closing value per token on 10th December, 2020 was US$17,926.11. The recent value (US$17,926.11) represents about 149% (US$17,926.11 – US$7,199.39) increase over the previous value (US$7,199.39).

1.2 PROBLEM STATEMENT

The first digital currency to be introduced to the global financial market is bitcoin. Due to its originality, bitcoin is described as the "mother" of all digital coins in the cryptocurrency industry; and believed to be one of the fastest medium of growing one's investment in the global financial and business community. Many investment analysts are of the firm belief that bitcoin is a useful financial tool in the investment world. However, it is fraught with challenges. For instance, bitcoin

traders in the cryptocurrency industry are not sparred of risk inherent in technological challenges, which negatively on impact smooth and successful investments in the virtual financial environment. As an example, it is not uncommon in recent periods to hear of hacking into the systems of digital exchange companies by predatory and unidentified hackers. These cyber-attacks often result in loss of valuable investment-sums by investors and virtual exchange operators to the hackers (Ashley, 2018).

Sanger (as cited in Ashley, 2018) and Kasner (as cited in Ashley, 2018) noted failure on the part of managements of various digital exchanges to identify, develop and implement strategies that would consolidate and assure protection of their respective digital systems and networks would have dire consequences for the cryptocurrency industry and investors. This corroborates Baboo and Kumar (as cited in Ashley, 2018) who found the absence of adequate security measures could have strong negative implications for firms in the global virtual currency markets. For instance, in early 2014, the system of Mt. Gox in Japan was hacked into and bitcoins totaling 850,000 were lost to hackers. These bitcoins were valued at US$474 million. The loss led to the collapse of the Mt. Gox virtual exchange market in February 2014, although Mt. Gox later found 200,000 of the stolen bitcoins. The compromise on Mt. Gox's virtual currency platform was blamed on transaction malleability (Kirk, 2016). That is, the tendency for a chain of unconfirmed transactions to be transmitted to recipients.

However, the nefarious activities of predatory hackers continued unabated. In June 2016, an experimental investment fund known as the Decentralized Autonomous Organization was hacked into and ether worth US$55 million was stolen. On 2nd August, 2016 Bitfinex, one of the largest American dollar-denominated bitcoin exchanges across the globe announced a hack into its digital currency platform and loss of 119,756 bitcoins as a result thereof to hackers. The system-hackers were able to hack into the virtual exchange in Hong Kong; and the value of bitcoins lost to the hackers was estimated at US$69 million based on the exchange rates on 4th August, 2016. The system-hacks affected the market value for bitcoin; there was 20% drop in bitcoin's market value following Bitfinex's announcement on hacks into its digital financial systems. The losses incurred by Bitfinex were the second-highest after Mt. Gox (Kirk, 2016). In 2018, the global cryptocurrency markets were saddled with another system-hack. The initial target, however, was NEM coins exchange located in Singapore. Eventually, the platform of Coincheck, a leading Japanese digital exchange, was hacked into, and investments worth US$530 million were lost to the sophisticated hackers.

The general management problem is the inability of Bitcoin exchanges in the global digital currency markets to develop, adapt and implement measures that would curb, significantly, security breaches; and to ensure valuable investments of investors are adequately protected. Bertot, Jaeger and Hansen (as cited in Ashley, 2018) argued firms in the virtual currency industry require novel strategies to effectively avert the activities of predatory hackers who periodically hack into their systems to deny investors of their valuable investments. Though evidence of the phenomenon exists, there are limited empirical studies to clearly establish the effect of bitcoin trading activities on all cryptocurrencies and on the global economy.

The specific management problem is the level of employee skills and training needed to ramp-up the level of expertise in information technology for digital currency control applications by the various Bitcoin exchanges in the cryptocurrency industry in particular, and in the global virtual financial markets in general, so as to minimise the frequency of huge investment losses to hackers. The present study sought to examine how trading activities related to bitcoin affect all cryptocurrencies in the global digital currency markets and global output.

1.3 RESEARCH OBJECTIVES

1.3.1 General Objective

The underlying objective of this research was to assess how trading activities related to bitcoin impact on the performance of all cryptocurrencies in the global digital financial markets; and on the global economy.

1.3.2 Specific Objectives

Specifically, the research sought to achieve the following objectives:

1. Assess the measurement module and markets for bitcoin.
2. Evaluate risk and economic value for bitcoins.
3. Analyse the market capitalisation value for bitcoin relative to total market capitalisation value for all cryptocurrencies and global GDP value.
4. Make recommendations for successful adaption and implementation of bitcoin for accelerated development of the global digital financial markets to facilitate their alignment with the mainstream global financial system.

1.4 CONCEPTUAL DEFINITIONS

For the purpose of this research, *token* referred to a unit of bitcoin and other cryptocurrencies referenced thereof. Further, *digital coin, digital currency,* and *digital token* were used interchangeably to refer to bitcoin and other cryptocurrencies in the global virtual financial markets. Also, *value per token, per-token value, price, price per token* and *market price* were used interchangeably with the same underlying meaning. That is, the unit price of bitcoin and any other cryptocurrency referenced during the research period. Finally, *market capitalisation* and *market cap* were used interchangeably to explain the total market capitalisation value for bitcoin and alternative coins (altcoins) referenced during the research period.

2.0 LITERATURE REVIEW

The foundation topic for development of the current research was: “Effect of Bitcoin Trading on the Global Economy.” The main purpose of this study was to examine the financial implications of bitcoin trading activities, including system-hacks and investment losses, for performance of all cryptocurrencies; and the global economy during the research period. This section presents review of existing literature; and synthesis of literature for the study. In a scientific inquiry such as this, it is imperative to identify relationships between the reviewed literature and research objectives; and between the research problem and reviewed literature. Further, it behoves the researcher to ensure these relationships exist; and this is evidenced in the current research. The fundamental question that undergirded the present research was: “What is the effect of bitcoin trading on the global economy?”

Data required for the conduct of the current research were obtained from text books, peer-reviewed articles published in journals, newspaper publications, digital currency markets; Google Search Engine including statista.com, ycharts.com; and electronic databases of international bodies such as the International Bank for Reconstruction and Development (World Bank), International Monetary Fund (IMF), and Organisation for Economic Co-operation and Development (OECD), among other significant sources. The following key words and phrases were used to generate relevant information from the Google Search Engine and other relevant databases for the discussion in this section: bitcoin, bitcoin exchange, cryptocurrency, types of cryptocurrency, digital exchange market, and virtual currency market.

Extended discussion in this section was facilitated under the following sub-themes: security in the digital currency market; and bitcoin as medium of exchange and store of value. Discussions in this section contributed significantly to the purpose of the research. That is, identification of security challenges that undermine effective trading of bitcoin on global virtual exchanges; and growing popularity which has impacted positively on the per-token and market capitalisation values for bitcoin in recent years. A theoretical framework preceded discussions on reviewed literature in this section.

2.1 Theoretical Framework

Many economists and experts in the art and science of finance believe investments hold the key to individual, institutional and national development. To this end, the concept deserves utmost attention in discourse pertaining to rational investment decisions. Generally, investment may be *private investment* or *public investment*. Either of the foregoing may be induced or autonomous investment. *Induced investments* are also called *income-elastic investments*, meaning they are investments that change when there is a change in individual, corporate or national income. Induced investments are pronounced in capitalist-driven economies where profits dominate the motive for investments. *Autonomous investments,* as the name implies, are independent by nature; they do not vary necessarily with changes in income or output. Profit motives do not dominate or influence such investment decisions. Thus, autonomous investments could be described as *income-inelastic investments* since they do not respond to variations in output; and are expected to pay for themselves over time. For instance, irrespective of national income or profit levels, economies were compelled to construct medical facilities, purchase personal protective equipment (PPE), and other medical logistics to contain and prevent further spread of the COVID-19 pandemic. This is classic illustration of autonomous investment.

The Psychological Law of Consumption propounded by the famous British Economist, John Maynard Keynes (5th June, 1883 to 21st April, 1946) (Britannica, 2020b) states inter alia, consumption increases as income increases. However, the increase in consumption occurs at a less proportionate rate comparative to increase in income. This implies a fraction of the income earned is not spent or consumed; it is saved.

A common belief held among some economists is discussions on investments often tend to focus on financial investment to the neglect of *real investment*. The latter relates to investments in the construction of new equipment, factory, buildings; and productive capital stock of communities such as roads, bridges, classroom blocks, and health facilities, to mention a few. Proponents argue real investments increase demand for physical resources and human capital, leading to increase in their respective employments in economies; and stimulation of real growth. *Financial investments* relate to the purchase of existing shares, stock, and securities including exchange traded funds (ETFs), virtual currencies, and bonds from the investment markets. Some economists argued financial investments do not create real employment opportunities since they involve mere exchange of funds or money from one person or organisation to another.

The dominant investment theories in macroeconomics include the neoclassical theory of investment, internal funds theory of investment, and accelerator theory of investment (Karmakar, n.d.). For the purpose of the current research, we focused on the accelerator theory of investment developed by John Maurice Clark, the renowned American Economist who lived from 30th November, 1884 to 27th June, 1963 (Britannica, 2020a). Popularity of the accelerator theory of investment in discussions related to the theories of economic growth and trade cycles cannot be over-emphasised.

2.1.1 Assumptions

The accelerator theory of investment was developed based on the following assumptions. First, investment has both induced and autonomous components; second, absolute levels of output or demand do not determine investment. Rather, investment is stimulated by rate of increase in total demand or net national product. Thus, investment declines as the rate of increase in income falls; investment increases as aggregate demand increases; and investment remains constant as rate of income is stable. Finally, investment is extremely volatile compared with other components of aggregate demand. That is, any percentage change in aggregate demand is likely to result in large percentage changes in investment in productive capacity (Nipun, n.d.).

2.1.2 Application

The accelerator theory of investment was developed on the fundamental premise that production of a given output level requires a particular amount of capital stock. That is, the theory identifies fixed relationship between output and capital stock. For instance, in order to produce GH¢200 million worth of output, a capital stock of GH¢600 million would be required. The foregoing could be expressed mathematically as follows:

$$X = K_t \div Y_t \quad \text{.....I}$$

Where:

X = Ratio of capital-output
K_t = Capital stock of the economy in period t
Y_t =Total output in period t

The relationship between output and capital stock could also be expressed as follows:

$$K_t = XY_t \quad \text{.....II}$$

Equation 2 tells us capital stock of the economy (K_t) equals the ratio of capital-output (X) multiplied by total output in period t (Y_t). Suppose X is constant. The following equation could be derived:

$$K_{t-1} = XY_{t-1} \quad \text{.....III}$$

Subtraction of equation 3 from equation 2 would lead to derivation of the following equation:

$$K_t\_K_{t-1} = XY_t XY_{t-1} = X(Y_t - Y_{t-1}) \quad \text{.....IV}$$

The accelerator theory of investment assumes net investments equal the difference between capital stock in period t and capital stock in period $t-1$. Therefore, net investments equal the product of the accelerator coefficient and change in output from period $t-1$ to period t. Under the accelerator theory, net investment (NI) is assumed to equal gross investment (GI) less depreciation (D) or capital consumption allowances (CCA). That is,

$$NI_t = GI_t - D_t \text{ or } CCA_t \quad \text{.....V; and}$$

$$NI_t - D_t = X(Y_t - Y_{t-1}) = X\Delta Y \quad \text{.....VI}$$

In equation 6, net investment during period t ($NI_t - D_t$) equals X, which is the accelerator coefficient multiplied by change in output (ΔY). Investment is a function of output since X is assumed to be constant; and increase in output means net investment is positive. Rapid increase in output is analogous with increase in net investment. Recall in our earlier example GH¢600 million worth of capital stock would be required to produce GH¢200 million worth of output. This implies X =

GH¢600 million ÷ GH¢200 million = 3. Thus, X which represents the ratio of capital-stock and output of the economy equals 3.

The theory suggests output would be worth GH¢200 million as long as aggregate demand remains GH¢200 million and capital stock is GH¢600 million. Further, net investment would be zero if aggregate demand is GH¢200 million because firms are not incentivised to increase their respective productive capacities. However, firms may be compelled to replace worn-out and deteriorating plant and equipment (P&E). As a result, gross investment would be positive.

Since the ratio (X) between output and capital is assumed to be fixed, an increase in aggregate demand from GH¢200 million to GH¢210 million implies an increase in capital stock of the economy from GH¢600 million to GH¢630 million, if output is also expected to increase to GH¢210 million (from GH¢200 million). This means for production to increase to the level of GH¢210 million, net investment (new investment in productive capacity) must equal GH¢30 million; the latter is the amount necessary to increase the economy's capital stock level to GH¢630 million. To illustrate, since X equals 3 and change in output equals GH¢10 million, net investment (GH¢30 million) equals the accelerator coefficient (X) multiplied by change in output. That is, GH¢30 million = 3 x GH¢10 million. Suppose the increase in output was greater. Net investment would have been larger, implying a positive relationship between the two variables – output and net investment.

2.1.3 Criticisms

The foregoing provides succinct explanation for the classical version of the accelerator theory of investment. Like many other theories, the accelerator theory of investment has been a subject for critique and criticisms by some experts in the field of economics and finance. For instance, a careful review revealed the theory provides explanation for net investment to the neglect of gross investment. However, the need to provide explanations for and determine aggregate demand affirms the relevance of gross investment to the theory.

Further, the theory assumes the elimination of discrepancy between actual and desired capital stocks within a single period. However, elimination of discrepancy in a single period may be practically impossible, if industries engaged in the production of capital goods are already operating at full capacity. Besides, gradual elimination of the discrepancy may be appropriate and economical even if the implied industries are operating at less than full capacity.

In addition, the accelerator theory of investment assumes firms and industries do not operate at excess capacity. That is, no productive equipment is allowed to lie idle; all productive equipment and facilities are employed in the manufacturing process. The theory posits net investment is positive when output increases, meaning the existence of excess capacity would lead to little or no net investment; firms are motivated to consider net investment when increase in productive capacity is assured. As a result, the theory may not be valid or applicable in periods of recession since periods of recession are characterised by excess capacity.

Also, the theory assumes a fixed ratio between output and capital stock. Although this assumption is occasionally justified, its continuous justification becomes problematic when companies substitute labour for capital, at least within a short time period. Companies are sometimes obliged to consider other pertinent factors, including interest rate in their attempt to optimise productive capacity; and this negates the assumption of firms' constant reliance on the fixed ratio between capital and output in making net investment decisions.

Moreover, suppose there is a fixed ratio between output and capital stock; companies do not have excess operating capacities; and there is an increase in aggregate demand. In this case, companies may be encouraged to make new investments in P&E in response to the increase in aggregate demand only if the new demand level would be sustained over a long- and not short period. Thus, temporary increases in aggregate demand may not be met with increased investment in plant and equipment. Rather, the implied company may consider stock-pile of production, price increases, allowance for extra work-shift hours by employees, and maintenance of current output levels as strategic ways of maximising profits other than increasing productive capacity and output through novel investment in plant and equipment.

Finally, the assumption of fixed ratio between output and capital stock; and the need for increase in net investment in response to an increase in aggregate demand suggests piecemeal expansion of productive capacity in response to aggregate demand increases in the short-run. However, this approach may not be economically viable to the implied company. This approach to the expansion of productive capacity in the short-run may not be possible, if the net investment is required in an industry that is highly driven by sophisticated and huge technological structures. In other words, the nature and type of industry influence a great deal, practical illustration of the assumption of fixed capital-output ratio, especially in the short-run. To this end, it is argued firms' decision to increase their respective productive capacities may not have a short-run focus; they may be seeking to address long-run productive capacity needs. Thus, companies may be strongly interested in substituting long-run productive capacity for piecemeal expansion of productive capacity in response to increases in aggregate demand in the short-run.

2.2 Security in the Digital Currency Markets

A major threat to trade and investment stability in the virtual currency markets is the attacks on virtual exchange technologies. The United States Secretary of Homeland Security (as cited in Finlay & Payne, 2019) suggested the risks associated with physical attacks do not measure up to the possible consequences of cyber-attacks, in terms of scope and breadth of the latter. Accurate identification of cyber-attacks' origin remains a strong challenge to technology and security experts. The high level of anonymity and limitless boundaries in the cyberspace facilitate masking of true identity and location by hackers.

Consequently, effectively identifying perpetrators of attacks in the cyberspace is extremely difficult. Hackers with strong technological sophistry could use different identity and location to create the impression that innocent third parties were responsible for the attacks. Finlay and Payne (2019) observed current provisions in international law do not allow any country to be held directly responsible for cyber-attacks by individuals, group or groups identified as non-state actors. That is, the activities of these individuals or groups are not controlled directly by the state; and the state neither acknowledges nor adopts their conducts as its own. Indeed, possible economic consequences of cyber-attacks on cryptocurrency markets and investors therein may be enormous as outlined in the problem statement section.

In spite of the numerous attacks on digital exchange markets and subsequent loss of investments worth hundreds of millions of dollars cumulatively, proponents of the digital currency system are still upbeat about current and future prospects of the cryptocurrency industry; and its ability to revolutionise the current global financial system, which they described as defunct or antiquated (Kirk, 2016). The foregoing argument raises doubt about the ability of recent cyber-attacks on Bitcoin networks; and platforms of other cryptocurrencies to derail the fundamental objective of digital currency developers and miners. That is, to emerge with virtual currencies that could defy

geographic distance and limitation; and condense the global business environment into "single and small global village" in terms of faster processing time for global financial transactions.

These positives notwithstanding, Valkenburgh (as cited in Kirk, 2016) noted the frequent security breaches witnessed in the virtual exchange markets was an attestation to vulnerabilities inherent in cryptocurrency technology platforms; and each hack presented digital platform managers with an opportunity to learn and grow resilient, implying virtual platform managers must resist the temptation to draw hasty conclusions, following system-attacks. Proponents' belief in potential of the digital currency markets to grow in leaps and bounds underscored the rebound in per-token value for bitcoin to US$580.00 after Bitfinex's announcement on system-attacks resulted in 20% plunge in its price per token.

Cheah (2020) believed the world is inching close to an era of financial system that is more decentralised and liberal than before. However, this remarkable feat is predicated on effective checks-and-balances to assure spread of potential benefits while minimising possible risks. The author argued effective management of the new virtual system remains a challenge to the global financial community in the next few years.

Kirk (2016) revealed the possibility for system-hackers to steal bitcoins when they access the private encryption keys of traders in the digital currency markets. However, all bitcoin-related transactions are recorded in the public blockchain; and this makes it easier for movements of stolen bitcoins to be traced. The algorithm and related features of bitcoin do not allow for its easy conversion to fiat currency when stolen; it is not feasible for hackers to cash colossal amounts of stolen bitcoins at renowned virtual exchanges, especially when the stolen bitcoins' address is closely-monitored. To ensure strict compliance with anti-money laundering regulations, managers of digital exchanges require identification of account holders.

Leins (2020) reported in July 2020, the Twitter accounts of some American stalwarts and celebrities were hacked-into by scammers. These iconic American figures included former President Barack Obama, and President-elect Joseph Biden. The rest were Messieurs Elon Musk (chief executive officer (CEO) of Tesla and Space X), Bill Gates (founder of Microsoft), Jeff Bezos (CEO of Amazon), Warren Buffett (CEO of Berkshire Hathaway), Michael Bloomberg (former Mayor of New York City, politician and businessman); Kim Kardashian and Kanye West (celebrities); and corporate accounts of Uber and Apple, among others. The primary objective of the hackers was to lure followers of these account holders to send US$1,000 in bitcoin with the false promise of remitting double the amount (US$2,000) to the senders. The hackers-cum scammers were able to net over US$50,000 from their innocent targets and victims.

However, Leins (2020) lamented the high level of anonymity in bitcoin account ownership makes it nearly impossible to trace the perpetrators. A preliminary investigation by Twitter revealed the hijack was a co-ordinated social engineering attack; Twitter believed the attack was orchestrated by individuals who successfully targeted its working staff with tools and internal systems access. The hack into Twitter accounts of these iconic figures revealed systems-hackers with technological sophistry could latch on to or exploit human vulnerabilities to access valuable information and data.

Protection for private keys and vaults of bitcoin in the virtual currency markets is carried out in a number of ways for the safety of investments. This protection notwithstanding, Bitcoin networks remain attractive targets to hackers because is it almost impossible to recover stolen bitcoins; completed bitcoin transactions are not reversible, unlike wire transfers in the banking industry (Kirk, 2016). This affirms the level of sophistry of hackers in the technological and financial world.

Digital currency analysts such as Kirk (2016) have emphasised the need for virtual currency exchanges to engage in difficult, but useful trade-offs by investing to raise the level of security around bitcoin; they argued improved security features would increase the complexity of bitcoin while minimising access by system-hackers. Lewis (as cited in Kirk, 2016) noted the existence of a balance between convenience and security in the virtual currency markets. He observed even though customers often clamour for improved security around their investments, their behaviour suggests their preference to convenience including making customers' private keys available on online machines. The author believed virtual exchanges which ascribe to this "convenient" request from their respective customers increase their risk of attack by predatory and sophisticated system-hackers.

Salami (2020a) described blockchain as an electronic medium for storing digital records of transactions. The blockchain platform allows individual records known as *blocks* to be linked together in a single list; this single list creates what is known as the blockchain. Blockchain by definition and function is expected to ensure consumers' transactions are end-to-end encrypted. Similarly, the primary function of cryptography employed in cryptocurrencies is to assure security of messages sent and received in the virtual currency transaction process. Cryptography ensures messages exchanged among traders in the virtual currency markets are not decrypted or stolen by hackers. The aim of digital currency developers and miners is to protect the privacy of participants or traders in the virtual financial markets (The European Business Review, 2020).

Parry (2020) found the New Zealand stock exchange was a subject for daily cyber-attacks for close to a week in August 2020. This impelled the Government Communications Security Bureau (GCSB) of New Zealand to issue alerts to all businesses to prepare for further cyber-attacks. The attacks affected effective functioning of public-facing websites in the country. The New Zealand government described the attack as part of worldwide malicious cyber activity; and would rather divulge sensitive and vital information through the links of government-to-government, Interpol and the intelligence alliance called *Five Eyes*. Experts described the attack as distributed denial of service (DDoS) type, which was not designed to perform insider trading or steal data, but to demand ransom from targets and victims. These hackers often ask for thousands of dollars to be paid for in bitcoin or altcoins which cannot be traced. Parry (2020) revealed pranksters, political groups and governments are noted for using these attacks.

Cheah (2020) described the revolution that introduced bitcoin in 2009; and later introduced other cryptocurrencies as disruptive financial technology. However, he argued change is urgently needed in the global financial industry; and that, a major obstacle to financial innovation is the hostile environment created by outmoded regulations ascribed for defunct era. The author bemoaned failure of some DeFi projects as result of this development. Cheah (2020) corroborates Brown and Whittle (2020) who found governments have resorted to the use of bureaucratic processes as strategic means to delay the pace of development and growth of virtual currencies and their markets across the globe.

Salami (2020a) noted security-threats posed by the virtual exchanges to the international investor-community. She argued, although news on the absence of intermediaries such as banks is refreshing to investors, it increases risk of their respective investments in the global virtual currency markets. For instance, transacting businesses through financial institutions such as universal banks and investment banks allow the investor to hold the financial institution accountable in times of discrepancies; and for sanctions to be applied when necessary by the regulator in its jurisdiction. The virtual financial system and non-regulatory measures of digital exchange markets increase the risk of investors' funds; and possible collapse of exchanges in the digital financial markets. Traders

are likely to forfeit all their investments in times of system-hacks as recorded in recent and prior years. For instance, Mt. Gox, the Japanese leading virtual exchange was forced into liquidation in 2014 after its system was hacked-into, and 850,000 bitcoins valued at US$474 million were stolen from its coin-vault. Some conservative investors contended the lopsided risks favour investments in stocks and other assets such as gold to the investment neglect of cryptocurrencies.

Potts and Rennie (2020) argued technocrats supporting the development and mining of virtual currencies have demonstrated tremendous improvements; technologies adapted to ensure successful operations of virtual exchanges across the globe have improved considerably in recent periods. To ensure transactions on various digital platforms are safe, each token is duly recognised with a unique number and not spent twice. Developers subject themselves to rigorous computing processes. Intensity of the computing process results in some carbon emissions. The volume of these carbon emissions are believed to be in excess of those generated in some economies across the globe. For instance, Potts and Rennie (2020) found total carbon emissions from bitcoin mining exceeded total carbon emissions generated in Sri Lanka. Reiff (2020) defined mining as the process of developing encrypted codes for creation of cryptocurrencies.

However, Potts and Rennie (2020) affirmed recent technological upgrade known as Eth2 embarked on by ethereum was expected to transition its existing platform from blockchain to a proof-of-state system. This initiative would reduce the intensity of man-hours required in the computing processes while improving on environmental challenges such as high carbon emission rates. Meanwhile, developers of the blockchain technology are introducing new layers to facilitate use of blockchain technologies in financial markets. The most recent of these new layers is ***decentralised finance***, also called ***DeFi*** (Salami, 2020a; Cheah, 2020). This new technology is relying on blockchain to build financial markets that are completely digital and automated without the need for intermediaries such as lawyers and banks. The new layers are expected to build on existing technologies in the virtual exchange markets to develop decentralised virtual exchanges; and to facilitate trade in derivatives without the services of traditional intermediaries such as central banks, universal banks, and stock markets. Potts and Rennie (2020) argued these developments in the global financial markets could only be made possible by blockchain and cryptocurrency infrastructure.

2.3 Bitcoin as Medium of Exchange and Store of Value

De Best (2020) recounted gradual acceptance of bitcoin as a medium of exchange for goods and services among retailers in the technologically-savvy industry; and increases in the number of bitcoin ATMs across the globe which are indicative of growing popularity and acceptance of bitcoin not only for investment purposes, but also for purchase transactions in many economies. These attributes notwithstanding, the current average confirmation time for bitcoin transactions is high relative to other technological platforms. This challenge renders bitcoin platforms less attractive and less suitable for small transactions. However, the introduction of altcoins such as litecoin, bitcoin cash and bitcoin SV to reduce transaction cost; and to allow for scalability and low average confirmation time helps to address the identified lag in current effectiveness of bitcoin for small transactions.

Brown (2020) believed a major challenge to the cryptocurrency industry is volatilities in per-token value for bitcoin. Some analysts argued the frequent volatilities do not encourage investors in the virtual currency markets to readily accept bitcoin and other cryptocurrencies as store of value and functional currency in the global business community. The volatilities lend credence and support to calls for ban on certain derivatives' trading in the cryptocurrency industry. The ban, it is believed,

would help reduce the level of volatilities in bitcoin and altcoins trading. However, effectiveness of an outright ban remains an on-going debate among some crypto experts.

Urquhart (2020) argued Satoshi Nakamoto's underlying objective for limiting the total number of circulated bitcoins to twenty-one million was to curb inflation. Indeed, there is a relationship between demand and supply; price equilibrium and price stability are assured when demand equals supply; price experiences upward adjustments when demand exceeds supply; and price is often reviewed downwards when supply exceeds demand. Therefore, Urquhart's (2020) argument of limited supply of bitcoins (21 million) could help fight inflation would hold when supply exceeds demand in the virtual currency markets.

However, steady increase in price per token of bitcoin in recent years does not support Urquhart's (2020) assertion. Evidence suggests growing acceptance of bitcoin and other cryptocurrencies, implying increasing demand relative to supply. Limited supply of bitcoin relative to "unlimited" demand in the virtual currency markets makes it an inflation-vehicle; per-token price is likely to increase exponentially when internal and external financial market conditions support investments in bitcoin. The inflation recorded through steady increases in price per token of bitcoin inures to the investment benefits of traders, especially hoarders in the virtual financial markets.

Market capitalisation value of circulated bitcoins as of early January 2020 was estimated at US$133 billion, equivalent to £102 billion. This was about 1.66% of the estimated global value of gold (US$8 trillion) during the period. Based on this relative comparison, Brown and Whittle (2020) concluded virtual currencies' chances of supplanting the global financial system in the immediate- or medium-term are remote. This assertion was significant to the current research which sought to examine the impact of market capitalisation value for bitcoin on global economic output.

De Best (2020) and The European Business Review (2020) identified a relationship among demand, price and market capitalisation for bitcoin. To illustrate, the number of bitcoins in circulation is 21 million. Due to the limited or fixed supply, the per-token value for bitcoin is dependent on its demand in the digital currency markets. Thus, all things being equal, increased demand relative to limited supply would lead to excess demand over supply; and this development could result in upward adjustment of bitcoin price in the cryptocurrency markets. Stated in different terms, increased demand over supply would lead to an increase in the per-token price of bitcoin. The predictability and slow pace of increases in supply of bitcoin suggest its market capitalisation value depends largely on the price per token. In the illustration, an increase in price per token multiplied by the total number of circulated bitcoins would assure higher market capitalisation value. To reiterate, the virtual currency markets are inundated with over two thousand different types of cryptocurrencies (Reiff, 2020). However, The European Business Review (2020) singled-out bitcoin as the most important for trading in the global digital currency markets.

Salami (2020a) observed some unique features associated with cryptocurrencies include decentralised services and absence of intermediaries such as banks. These qualities are believed to expedite transaction processes while eliminating several administrative bottlenecks that are believed to be antiquated; and retard financial progress in the business environment. These attributes encourage investors in the global stock markets to seek investment refuge in cryptocurrencies such as bitcoin when the stock markets are characterised by downturns. This explains significant gains made by bitcoin and other altcoins in 2020, in spite of the global financial downturn occasioned by the COVID-19 pandemic.

Brown (2020) estimated people in the United Kingdom with ownership in cryptocurrencies at 1.9 million, equivalent to 4% of the total adult population; and 2.80% of the mid-year estimated total

population of 67,886,011 people (Worldometer, 2021). However, overwhelming majority of these traders (about three-quarters) could be described as retail investors with holdings not more than £1,000.00. In 2019, one-fifth of UK's virtual currency traders invested in cryptocurrency derivatives. Thus, use of cryptocurrency futures and options as strategic hedge against underlying assets such as bitcoin and altcoins in the virtual financial markets was found to be on the rise in the United Kingdom. However, the author admitted the main users of cryptocurrency derivatives may not be retail investors; the latter may constitute a small fraction of derivatives users in the cryptocurrency markets. For instance, in early 2020, one of the cryptocurrency trading sites, eToro (as cited in Brown, 2020), noted only about one-tenth of the total retail investors on its platform invested in virtual currency derivatives. This is consistent with one of Ashley's (2018) recommendations which suggested the need for investment in bitcoin as a derivative by economies and corporate bodies (p. 226).

Urquhart (2020) revealed transparency in decentralised systems of virtual exchanges; ability to read available transactions on blockchain; and share of equal power among network members in the virtual financial system. On 11th May, 2020 bitcoin went through "halving;" the third in the series. Urquhart (2020) affirmed this important adjustment to the operation of bitcoin and other cryptocurrencies happens every four years. Although there are no clear reasons for developers and miners' decision to halve bitcoin after a certain period, speculations among some analysts were rife; they believed the initiative is intended to attract potential investors to the areas of systems development and mining to increase distribution of tokens in the virtual financial markets. Brown and Whittle (2020) described the process as an opportunity for system developers and miners to add new coins to the network; these newly-introduced coins are halved; and the "shortage" could drive per-token value of bitcoin upward.

Brown (2020) observed investors in the virtual financial markets tend to increase their chances of being highly levered when they purchase cryptocurrency derivatives. That is, the derivatives increase investors' borrowing and by extension increase the size of their respective trades for higher potential gains; and in some cases losses, especially when the virtual currency markets record downturns. However, investment leverages in the virtual currency markets vary from exchanges to others. For instance, some virtual currency exchanges allow investors to borrow more than hundred times the size of their respective trades while exchanges in Asia limit borrowing to fifteen times the size of investors' trades. Generally, investors enter and exit the virtual currency markets more frequently when their investments are leveraged; the leverage increases investors' trade gains or losses in proportion to their borrowing limits.

Public pronouncements of renowned CEOs, businessmen and women have the tendency to influence prices of assets such as bitcoin and other cryptocurrencies in the global financial markets. For instance, Del Rio (2020b) reported that simple tweets on dogecoin by Mr. Elon Musk on 20th December, 2020 were enough to increase the per-token value of the virtual currency (dogecoin) by 25%. Mr. Elon Musk is the CEO of Tesla and Space X; and the second-richest man in the world after Mr. Jeff Bezos, CEO of Amazon.

Urquhart (2020) noted as at 14th May, 2020 the total number of bitcoins in circulation were 18.38 million, meaning there were only 2.62 million (21 million – 18.38 million = 2.62 million) bitcoins left in the coin vault during the period. The author argued regular halving of bitcoin may encourage investors to hold on to bitcoin as a speculative asset rather than perceive it as a medium of exchange or fiat currency such as the American dollar and British pound sterling. Extant literature suggests although bitcoin is experiencing growing popularity in its use for purchases in international

transactions and markets, many consumers still focus attention on its viability for investment purposes than for purchases.

In spite of the risk therein, investors in the virtual currency markets are always looking for volatilities in bitcoin trading to maximise profits. De Best (2020b) argued merchants' limited knowledge about Bitcoin network and its related technology coupled with bitcoin's volatility affirms their reluctance to generally accept it as a medium of payment for certain transactions. The increase in number of circulated cryptocurrencies (over 2,000 digital currencies) as at January 2020 (Reiff, 2020) was indicative of growing competition, though bitcoin remains the dominant force in the virtual currency markets. To re-echo, bitcoin is the original and first-ever popular digital currency; and currently controls more than 40% of the cryptocurrency markets (The European Business Review, 2020). Further, improvements in Bitcoin network's services, including consumers' ability to convert bitcoin into cash with relative ease; and popularity of bitcoin facilitate its exchange for the American dollar and European euro. The volume of bitcoin trading is very high; and investors could obtain bitcoins from all the virtual exchange markets across the globe.

Other successful businessmen and women have also wielded into the debate on the pros and cons of trading in bitcoin and other cryptocurrencies in the global digital currency markets. In a recent interview with Forbes (as cited in Entrepreneur Staff, 2020c), Mr. Mark Cuban, the American businessman, investor, billionaire and owner of the Dallas Mavericks baseball team in the United States down-played the future fortunes of bitcoin, in spite of its extraordinary rise in value in recent periods. Mr. Cuban was indifferent in opinion on bitcoin; he argued bitcoin does not and would not have the magic-wand to be transformed from an "ordinary" financial tool into a reliable currency. He asserted bitcoin belongs to the gold-asset category which has succeeded in moulding itself more into a religion than proffering solution to challenges in the global investment and business community.

Further, Mr. Cuban (as cited in Entrepreneur Staff, 2020c) described on-going public discourse on bitcoin's ability to replace fiat currencies as counter-productive. His argument stemmed from the fact that economies would take proactive and reactive steps to counter measures that would restrain their ability to impose taxes; and to protect their respective national legal tenders. This development, it is believed, would not increase the investment population that would be interested in bitcoin as a store of value since the latter has the tendency to increase governments' interventions or counter-measures in the operations of virtual currency markets. The foregoing notwithstanding, bitcoin and gold have been described as rare assets; and important vehicles for store of value in recent years. This recognition is affirmed by bitcoin's classification alongside gold as a commodity by the United States Commodity Futures Trading Commission (CFTC).

Brown (2020) concluded the effect of investors' leveraging activities on the market contributes immensely to price volatilities. This notwithstanding, in recent periods, bitcoin has been noted for trading at an all-time low for volatility, implying the intended ban on trading in cryptocurrency derivatives by amateur investors may not serve useful investment-security purpose. However, the author did not underestimate the overall essence of United Kingdom's intended ban on investment in cryptocurrency derivatives by inexperienced traders in the virtual currency markets.
Financial regulators' decision to indict operators of some virtual exchanges for various breaches may have dire consequences for the cryptocurrency industry; investors may not become nonchalant as a result, and may decide to withdraw their respective investments. This development could create liquidity crisis in the digital currency markets **(**Brown, 2020). However, this may be limited to virtual exchanges in the implied jurisdictions. That is, the overall effect of the foregoing measures on the global cryptocurrency markets may be insignificant since use and popularity of bitcoin and

other cryptocurrencies continue to surge; and the ban may affect only operators in prohibited jurisdictions.

Brown (2020) asserted efficiency of virtual financial markets is enhanced by derivatives trading; the latter contributes to increased market efficiency by allowing investors to hedge their bets against underlying assets. To this end, a partial ban on derivatives in one jurisdiction may be perceived as a setback to development of the global cryptocurrency industry. Inherent threats to the global cryptocurrency industry may soon draw reactions from major regulators such as the Federal Financial Services Authority (BaFin) in Germany; and Securities and Exchange Commission (SEC) in the United States.

Urquhart (2020) found the decision to halve bitcoin has some implications; total number of bitcoins circulated daily would reduce to half while daily revenue derived by miners could also reduce to half. As an illustration, suppose 12,000 new bitcoins were circulated daily prior to the halving. Implementation of the halving system means the number of bitcoins circulated daily would reduce from 12,000 to 6,000; and miners could now derive revenue from the sale of 6,000 bitcoins instead of 12,000 bitcoins. Halving is to some extent analogous with a split that results from hard fork. All else held constant, until the halving results in the emergence of a new digital coin, there would be shortage in supply of bitcoins in the virtual currency markets. Some analysts argued this development could lead to an increase in per-token value of bitcoin through the creation of bullish market condition while least efficient miners may be compelled to exit the virtual currency markets due to reduction in their earnings or revenues.

Licardo (2020) found entrepreneurs have joined in the growing debate on investments in the cryptocurrency industry. With the recent spate of per-token value increases, entrepreneurs have begun to wonder if their failure to adapt bitcoin as a medium of payment could potentially result in a missed opportunity; and even compromise growth of their businesses in the medium- and long-term. Notable organisations such as AT&T, Microsoft, Wikipedia, and many others, have started accepting bitcoin as payment method and option. In addition, about one-third of small and medium-size businesses in the United States were reported to have joined in the recognition of bitcoin as a means of payment for various transactions while some banks were accepting bitcoin as a deposit method. Finally, bitcoin exchange traded funds have become common investment source in the United States in recent periods.

Brown (2020) argued the decision by financial regulators in the United Kingdom to place a ban on investments in cryptocurrency derivatives by inexperienced investors was in order, given the enormity of risks inherent in cryptocurrency trading; and excessive risks taken by most unprofessional investors in the virtual currency markets in the United Kingdom, Europe and across the globe. The author's argument suggests each economy could tailor her regulations to suit and address identified challenges; the regulatory measures and approach may not be blanket across jurisdictions. Jorner (2020) likened the role of digital currencies in the global financial markets to the role of email in communications; and concluded that popularity of bitcoin as a means of transferring value within and across borders is on the significant increase

Jorner (2020) affirmed current transactions and payment methods in the global business sphere attest to the fact that we find ourselves officially in the *Fintech age*. The author submitted the recent COVID-19 pandemic and its resultant social and physical distancing rules coupled with increased cashless payment methods have propelled bitcoin and altcoins into the mainstream global financial system; and these cryptocurrencies are having profound influence on the *modus operandi* of the global financial system. Jorner (2020) argued the technology behind digital currency is real. As a

result, there is an increasing shift in paradigm from the traditional payment methods to the digital payment age, which has speed and easiness as some of its unique benefits.

Potts and Rennie (2020) found token-swaps in the virtual financial markets were becoming a common place owing to the adaption and use of bitcoin and altcoins through the *stablecoins system*, which allows investors to hedge against values for fiat currencies of key central banks such as the American dollar, British pound sterling, European euro, and others. Brown and Whittle (2020) and Cheah (2020 described the stablecoins system as hybrid of virtual currencies living on blockchain technology platforms, and pegged to mainstream fiat currencies. It is worth-asserting the respective unit values for the American dollar (US$1.00) and British pound sterling (£1.00) on 26th December, 2020 were a far-cry of per-token value of bitcoin denominated in the American dollar (US$24,826.14) (Coindesk, 2020). Undoubtedly, cryptocurrencies have emerged on the global financial markets as a new asset class (Nadler & Guo, 2019).

Brown and Whittle (2020) maintained some multinationals would latch on creation of the stablecoins technology to heave some sigh of relief in the global financial system. Multinational institutions may attempt to challenge sovereign money by opting out of the current global financial system they have been impelled to operate in; and which many have described as clumpy with its attendant delays in international payments; and high transaction fees. The stablecoins system presents multinational institutions with unique opportunity to present their clients with an appealing alternative to the existing global financial system, which has been described as antiquated (Kirk, 2016). Brown and Whittle (2020) contended some multinationals are not lending their support to bitcoin and other cryptocurrencies. Rather, the multinationals are considering invention of the stablecoins system because they believe bitcoin and other cryptocurrencies have as many challenges as the mainstream financial system they seek to opt out of.

Urquhart (2020) estimated gains made by bitcoin in the virtual exchange markets from January through May 2020 at 20%. The estimated gains (20%) were prior to the halving on 11th May, 2020. The previous halvings were believed to have resulted in stagy bull runs in the history of bitcoin. However, the halving in May 2020 coincided with global economic challenges occasioned by the predatory COVID-19 pandemic. The pandemic outbreak compelled international financial bodies such as OECD, World Bank and IMF to review their respective global GDP growth targets for 2020. In its April forecast, the IMF predicted 3% decline in global GDP growth target for 2020; and the growth target was expected to decline further. Economic challenges in the United Kingdom in the wake of the pandemic impelled the Bank of England to project 30% decrease in the country's GDP in the first half of 2020. These global economic and financial challenges and uncertainties were expected to have adverse effects on trading of bitcoin in the digital currency markets.

Jorner (2020) reminded financial actors that we cannot find ourselves in the global economy and continue with transactions like a small town whose progress is strained by local restrictions to payment methods, excessive charges, avoidable taxes on transactions; and financial systems that are over fifty years old and need an overhaul. The author's argument corroborates clarion calls by some economic and financial analysts for the existing structures related to the global financial system to be reviewed, rebranded and tailored to synchronise with current trends in the global financial markets, including rapid recognition of novel cashless system couched in bitcoin and altcoins.

Dynamics in the virtual currency markets and the global business environment in general prompted Brown and Whittle (2020) to conclude by 2030, it may probably be difficult to recognise money based on its known-functions today. This presumes virtual currencies are beginning to reshape the appearance and functions of traditional fiat national currencies. The authors predicted the extent of multinational influence in nation-states in the second-half of the current century presupposed the

next bitcoin would emerge from the multinational world, either with a corporate brand or sovereign flag. Stated in different words, the existing bitcoin and altcoins do not hold the key to the future of the global cryptocurrency industry. Rather, sovereign or corporate virtual currencies would be created to dominate and assure success of the virtual financial markets.

Periods of global economic uncertainties tend to impact negatively on the performance of stocks, but favour other investment assets including cryptocurrencies. It is argued currencies of some economies become vulnerable to devaluation during economic crisis periods such as the recent outbreak of COVID-19 (Urquhart, 2020). This exchange volatility makes bitcoin useful alternative investment tool in financial crisis periods; individuals, corporate bodies and governments could invest in bitcoin as a derivative to hedge against their national fiat currencies. Investments in bitcoin and other reliable cryptocurrencies during economic crisis periods provide the requisite insurance cover and protection for fiat currencies, national debts and national investments. The foregoing statement holds for individual and corporate investments.

High volatility strongly affects price stability in the virtual currency markets; price per token quoted today may differ tomorrow; the price may increase or decrease depending on internal and external market conditions. In spite of these challenges, Potts and Rennie (2020) believed the “scripts” for bitcoin and other cryptocurrencies were being rewritten; analysts could attribute substance to increases in price per token of digital coins in the virtual financial markets. This douses the flame of uncertainty which had surrounded trading activities of bitcoin and altcoins in prior and recent years.

One of the main reasons for regulators in the United Kingdom’s decision to ban amateur investors from trading in cryptocurrency derivatives was lack of reliable basis for valuation of bitcoin and altcoins (Brown, 2020). Some analysts described this “reason” as an improvement over earlier one which stated there was no “scientific” basis for valuation of cryptocurrencies. Nonetheless, bitcoin and altcoins are believed to be speculative and volatile assets (Potts and Rennie, 2020). The tendency to gain or lose is high; and prevailing market conditions call for due diligence and rational decisions on the part of investors. Should the virtual currency markets witness sustained price increases over a long period without a bubble burst, it may be as a result of the transition of cryptocurrencies from the current state of “who wants to get-rich quickly?” to a state characterised by stable economic infrastructure (Potts and Rennie, 2020).

Brown and Whittle (2020) contended it is extremely difficult for governments to control cryptocurrencies because they are underpinned by encrypted blockchain technology. The encryption makes any decision to completely eliminate virtual currencies unlikely to be feasible. The authors averred the indispensable role of bitcoin and altcoins in geopolitics; cryptocurrencies serve as geopolitical hedge in periods of international conflicts: the recent escalation in tensions between the United States and Iran led to increases in demand; and increase in token price of bitcoin and altcoins in the cryptocurrency markets across the globe. Consequently, investors are beginning to seek refuge in bitcoin and other cryptocurrencies in times of uncertainties in the global stocks and other related markets.

Nadler and Guo (2019) sought to ensure fair evaluation of digital tokens through the estimation of their pricing kernel, a pricing factor used by investors to determine their virtual currency holdings. The authors investigated how traditional risk factors including market risk were evaluated; and how specific risk factors related to blockchain were considered in the pricing process. To achieve the foregoing objective, the researchers adapted an asset pricing model and modified its properties to align with virtual currency markets. Findings from the research revealed paradigm shift in risk factors from bitcoin to ethereum-specific risk factors. Further, the research outcomes revealed specific risk factors of blockchain were considered in determination of the price per token for digital

currencies. Growing importance of market factors served as evidence for separating on-chain from off-chain trading activities in the cryptocurrency markets.

Potts and Rennie (2020) outlined and explained three underlying reasons for recent changes in perception of key financial regulators and financial institutions on the economic usefulness of bitcoin and other cryptocurrencies to the global financial markets; and to the global business community. These included the introduction of a new digital currency; maturing state of cryptocurrencies' technology; and growing appreciation for the value of bitcoin and other cryptocurrencies. The authors asserted the fundamental objective for the introduction of novel digital currency is to facilitate domestic and international trade; and to ease payments involving huge sums of money within and across borders. One of the non-pharmaceutical interventions identified as useful to curbing further spread of the COVID-19 pandemic was physical and social distancing. Effectiveness of the foregoing called for the implementation of cashless payment systems, paving way for accelerated interests in digital currencies such as bitcoin and altcoins. Today, bitcoin facilitates activities in the digital economy including trading in gold and leading stocks of companies such as Zoom, PayPal, Apple, Microsoft, Amazon and Etsy.

In spite of the initial apprehension, anxiety and rejection, Potts and Rennie (2020) found growing popularity of bitcoin and other cryptocurrencies among institutional investors across the globe. For instance, the CEO of BlackRock, Mr. Rick Rieder, was of the firm belief that cryptocurrencies have come to stay in the global financial and business markets. BlackRock is the leading investment funds management company across the globe with assets worth over US$7.4 trillion under its management. As at November 2020, total cryptocurrency assets held for institutional investors by Grayscale Investments, a managing firm for cryptocurrency assets based in the United States, were valued over US$10 billion. In the first week of December 2020, Guggenheim Partners announced its ability to invest up to US$530 million in bitcoins through Grayscale Investments. Guggenheim Partners is a global financial services company managing assets worth more than US$275 billion.

Salami (2020b) found steady growth in the market for crypto-lending and its possible entrenchment due to the introduction of new financial services regulation which seeks to align cryptocurrency transactions with banking services. Beyond the ordinary, the author was convinced the extent of service-growth places the market for crypto-lending in a position to replace traditional banking services in the next few years while the role of crypto-assets in mainstream global finance cannot be underestimated. The principal objective for creation and introduction of bitcoin and other cryptocurrencies is to liberate investors from the "shackles" of the traditional global financial system; and from the claws of elites who control it. Contrary to initial expectations, the traditional global financial system and its elites are embracing cryptocurrencies and their accompanying technologies.

Due to the perceived inherent high volatility in bitcoin and altcoins, Brown and Whittle (2020) were optimistic that either sovereign or corporate digital tokens or both hold the key to the future of the cryptocurrency industry. The authors argued the sovereign and corporate systems which were alleged to be under threat from bitcoin and altcoins are rather beginning to appreciate; and are already in the process of adapting digital coins. Perhaps, the sovereign or corporate digital coins to be created would not use blockchain technology; their functions may be similar to those of WeChat Pay or PayPal.

Notwithstanding the fortunes made by some individual and institutional investors in bitcoin and altcoins trading, Potts and Rennie (2020) postulated the decision to invest in cryptocurrencies at the peak of the market remains a gamble; and that, the ideal period to invest in virtual currencies is when the markets are crowded with uncertainties and unit prices of virtual currencies are low. All

else held constant, during peak market periods, investors' risk of buying high and selling low increases due to a possible bubble burst, which could plunge per-token prices. However, investors' risk (when they enter the virtual markets during peak periods) may be lower, if factors such as speculations are controlled to assure market stability through sustained and uninterrupted trading activities; and stable prices of digital currencies.

Brown and Whittle (2020) claimed some principal actors in the global financial markets such as multinational institutions are reluctant to use bitcoin and other cryptocurrencies as store of value due to the high volatility inherent in their respective prices per token; and their yet-to-be impressive processing of financial transactions. Besides, most multinational institutions perceive the creation and launch of their respective digital currencies as an opportunity to increase customers' experience while they gain total "customer" control by selling goods and services; and introducing a new service, that is, monetary system to facilitate payments for transactions. In essence, each multinational has the opportunity to become one-stop-shop for its individual customers and corporate clients.

Salami (2020b) saw bright future for bitcoin and altcoins in the global cryptocurrencies markets. However, the foregoing optimism was at variance with the pessimism expressed by Brown and Whittle (2020); these authors argued the productive days of bitcoin and already-existing altcoins in the virtual exchange markets across the globe are numbered; and that, sovereign coins or corporate coins, or a combination of the two would soon dominate the global virtual financial markets. Nonetheless, available data on per-token and market capitalisation values for bitcoin and altcoins support Salami's (2020b) argument.

A co-founder at Chainlink, Mr. Sergey Nazarov (as cited in Nagarajan, 2020), identified three theories which support bitcoin's role as an alternative to existing fiat currencies. These include constant increase in inflationary levels; increased institutional adoption of crypto-solution; and increased security for financial products stemming from decentralised financial ecosystem. Investors rely on this measure to combat inflation. Mr. Nazarov (as cited in Nagarajan, 2020) argued bitcoin's ability to break the US$20,000 threshold in value per token proved the foregoing theories.

Del Rio (2020a) noted predictions by some virtual market analysts that the per-token price for bitcoin would soon be quoted at US$30,000. Similarly, Mr. Alex Mashinsky, CEO of Celsius Network (as cited in Nagarajan, 2020) believed bitcoin's price per token would hit the US$30,000 threshold. However, he maintained the per-unit price may thump between US$14,000 and US$16,000 through speculations in the financial streets and rebound to higher price levels. Mr. Mashinsky (as cited in Nagarajan, 2020) believed this slump in price to between US$14,000 and US$16,000 would be the only time investors may have the opportunity, ever again, to purchase bitcoin at a price lower than US$20,000. The submission affirmed Mr. Mashinsky's (as cited in Nagarajan, 2020) conviction in long-term sustainability of bitcoin trading and related activities in the virtual currency markets across the globe. This was corroborated by Jorner (2020) who concluded bitcoin and altcoins have come to stay in the global financial markets.

Jorner (2020) maintained the argument that digital tokens are not yet applicable to daily living and payment needs may hold in 2009 when bitcoin was first introduced as an example of cryptocurrencies. However, with passage of time and current innovations in the digital currency markets, the foregoing argument may not hold; the argument may not pass practical tests on cryptocurrencies including bitcoin in contemporary periods. Licardo (2020) identified and summarised benefits to be derived from bitcoin into four. These include lower fee payments, protection against fraud, transaction easiness, access to international clients; and creation of media

and brand awareness. The author noted trading in bitcoin provides dual benefits; it helps concurrently to increase awareness of the selling company's brand; and to market bitcoin and other cryptocurrencies that may be traded on the virtual exchanges.

Jorner (2020) asserted trading using bitcoin guarantees faster payments, convenience, easiness and affordability. Emphasis on faster payments as one of the benefits of bitcoin by Licardo (2020) and Jorner (2020) is at variance with Reiff (2020) who found altcoins such as litecoin and bitcoin SV were created to improve on the slow transaction processing pace and time of bitcoin. Perhaps, Satoshi Nakamoto and his team of developers have been able to improve on the transaction speed of bitcoin to merit such attribute from Licardo (2020) and Jorner (2020).

3.0 RESEARCH METHODOLOGY

The quantitative approach to scientific inquiry was adapted and used in the current research. Specifically, a cross-sectional design, an example of survey design, formed the basis for the research. This design allowed the researcher to gather relevant research data over a specific time frame (Ashley, Takyi & Obeng, 2016; Creswell, 2009; Frankfort-Nachmias and Nachmias, 2008). Data required for the conduct of the current research were obtained mainly from secondary sources. These included text books, peer-reviewed articles published in journals, newspaper publications, and digital currency markets. Other sources were Google Search Engine including statista.com, ycharts.com, crowdfundinsider.com, finance.yahoo.com; and electronic databases of the World Bank, IMF and OECD, among other significant sources. Respective data on quarterly circulated bitcoins, quarterly bitcoin prices and quarterly market capitalisation values for bitcoin from 2012 through 2020; annual market capitalisation values for all cryptocurrencies from 2013 through 2020; and annual global GDP data from 2012 through 2020 were used in the study.

3.1 Analytical Tools

Descriptive statistics and regression models were used to describe the research variables; and to evaluate their behaviour over the stated time frame on global GDP. Measures such as standard deviation and range were employed to describe the extent of dispersion about the central tendency (Ashley et al., 2016; Creswell, 2009; Frankfort-Nachmias & Nachmias, 2008). These measures were used to describe trends in circulated bitcoins, value per token, market capitalisation values for bitcoin and all cryptocurrencies; and annual global GDP values during the research period.

3.2 Research Variables

The ***independent*** research variable was ***annual bitcoin market capitalisation value*** while the ***dependent*** research variables were the relative effect of annual bitcoin market capitalisation value on the ***annual market capitalisation value for all cryptocurrencies****; and* the effect on ***annual global GDP value***.

3.3 Regression Model

Regression statistical model was adapted to measure the effect and level of interaction of annual bitcoin market capitalisation value on annual market capitalisation value for all cryptocurrencies; and on global GDP value over the research period. With the recent spate of system-hacks and eventual loss of large amounts of bitcoin and huge sums of money (often quantifiable in American dollars) by virtual exchange operators and investors to predatory hackers, it was imperative to examine the impact of bitcoin operations on all cryptocurrencies in the global virtual financial markets; and the impact of same on the global economy, so we could determine the extent to which investment losses through bitcoin trading could have devastating impacts on development of the global virtual financial markets; and telling effect on global GDP.

Stated differently, it was necessary to assess how a loss by bitcoin traders to system-hackers could negatively impact the global financial markets and the global economy in general. Every economy thrives on the efficiency and effectiveness of its financial system. Thus, it was imperative to examine the extent to which bitcoin trading activities could affect rigidity and robustness of the global financial system, and by extension, the global economy. The research sought to measure the extent to which in a given financial year, cryptocurrencies such as bitcoin could significantly impact on the outcome of economic activities at the global level, controlling for other determining factors such as outputs and performance of the agricultural, industrial and services sectors. Bitcoin and other cryptocurrencies' trading activities could be traced to the services sector. The Microsoft Excel analytical software was adapted and used in the research. Diagrams and tables were derived from Microsoft Excel to explain the research data.

3.4 Research Hypotheses

The current research tested causal relationships between annual bitcoin market capitalisation values and annual market capitalisation values for all cryptocurrencies; and between annual bitcoin market capitalisation values and annual global GDP values, using the following null and alternative or research hypotheses:

3.4.1 Research Hypothesis One

Ho: μ1 = μ2; this implies annual bitcoin market capitalisation value has no strong effect on annual market capitalisation value for cryptocurrencies

H_1: $\mu_1 \neq \mu_2$; this implies annual bitcoin market capitalisation value has strong effect on annual market capitalisation value for cryptocurrencies

3.4.2 Research Hypothesis Two

H_o:μ_1 = μ_2; this implies annual bitcoin market capitalisation value has no significant effect on annual global GDP value

H_1:$\mu_1 \neq \mu_2$; this implies annual bitcoin market capitalisation value has significant effect on annual global GDP value

4.0 RESEARCH FINDINGS AND DISCUSSIONS

Extant research (La Monica, 2013; Reutzel et al.; Rooney, 2013; Stalnaker, 2013; Price, 2016; Hodge, 2018; Tassev, 2018) revealed divergent views expressed by financial analysts on the prospects of bitcoin in the medium- and long-term. Some crypto experts predicted the per-token value of bitcoin would soon be quoted at US$30,000 while others argued the future of bitcoin cannot be predicted with ease; it is quite challenging to predict with precision, what would become of bitcoin in the medium- and long-term due to the inherent characteristic of high volatility (Brown & Whittle, 2020). However, Urquhart (2020) and Potts and Rennie (2020) argued relatively stability and frequent upward price adjustments were indicative of low bitcoin volatility in the global virtual currency markets; and the likelihood for the virtual currency to witness price-surge. The lopsided argument on prospects of bitcoin favoured proponents of bright future for the virtual currency. As of 4th January, 2021, per unit price of bitcoin was over US$31,000. The price of gold per ounce on 7th January, 2021 was quoted at US$1,926 (Monex.com, 2021); and the price per token of bitcoin during the period was US$37,489.16 (Coindesk, 2021), implying a bitcoin was equivalent to 19.47 ounces of gold. That is, one required about 19.47 ounces of gold to obtain a token of bitcoin during the period.

Ashley (2018) revealed China was least fancied as *a free market* in the global economy. Yet, China has made giant strides at the national level to adapt and use bitcoin and other cryptocurrencies for transactions and payments while the *Apostles* of *free market* economy, the United States, were still struggling to come to terms with the dynamics and prospects of cryptocurrencies, including bitcoin for national economic stimulation and growth. In 2013, bitcoin gained national recognition in China; it was positively featured in state-run CCTV television network and government-backed newspapers. During the period, Chinese investors expressed strong optimism about the future prospects and potential growth of bitcoin and other cryptocurrencies in the global financial and business markets. The optimism expressed by Chinese investors had come to fruition during the research period; unforeseen and foreseen internal and external factors which affect performance of mainstream financial investment assets such as stocks make bitcoin and altcoins strong investment alternatives, in addition to gold. Strides made by bitcoin, the original cryptocurrency since 2009 till date, are simply phenomenal and remarkable. Evidence on performance of bitcoin in the global virtual currency markets thus far supports the "Yea-Sayers" and not the "Nay-Sayers."

In April 2013, bitcoin survived a bubble burst in the financial markets. This led some crypto analysts to conclude the virtual currency had come to stay; and that, it has the requisite shocks to withstand the test of financial turmoil. This was corroborated by the outcome of a research conducted by the Chicago Federal Reserve which revealed the use of bitcoin in mainstream financial and business transactions was limited. However, the virtual token could be adapted and used by banks and governments because its technical and conceptual achievements are simply remarkable. In September 2013, Bitcoin Investment Trust was launched in the United States to manage cryptocurrency assets. It is one of the pioneering trust companies dedicated solely to cryptocurrency asset management. The company was able to accumulate US$15 million barely two months after its launch (Ashley, 2018).

Ashley (2018) argued although gains from investments in cryptocurrencies remain very strong and attractive, the stakes are still high, implying massive investment in bitcoin and altcoins would be appropriate for *aggressive* and *moderately aggressive investors*. Cryptocurrency investments may not be conducive for conservative investors until regulatory measures are firmed-up in individual economies to assure higher safety of investors' funds.

4.1 Economic Benefits to Traders

Rooney (2013), Price (2016), Reutzl et al., Yellin et al., Jorner (2020) and Licardo (2020), among others, ascribed diverse reasons to justify relevance of bitcoin to local and international transactions in the 21st century and beyond. Some of the reasons outlined by these authors included first, the absence of potential middlemen such as banks and other deposit-taking financial institutions in bitcoin transactions. This allows traders to avoid the challenges associated with using banks for business transaction purposes. Second, financial activities and transactions of bitcoin are not regulated by central banks; the approvals or sanctions of central banks are not required to use bitcoin. Here, strict supervision and imposition of taxes and charges through the commercial banks are avoided (Ashley, 2018).

Third, using mobile apps and computers, traders could circulate bitcoins among themselves. The mode of transmission is not distinct from what pertains in the realm of digital cash transaction systems. Like mobile money transactions, bitcoin increases the amount of money in circulation in various economies; bitcoin reduces, considerably, the amount of money kept in personal vaults in homes and offices. It is envisaged bitcoin and other digital currencies would ensure the financial inclusion of more than 2.5 billion unbanked individuals across the globe (Ashley, 2018). As at 31st December, 2020, there were over 18.6 million bitcoins in circulation. Given the price of each

bitcoin at US$29,053.17, the market capitalisation value for circulated bitcoins on various virtual exchanges across the globe was equivalent to US$540.4 billion (US$29,053.17 x 18,600,000 bitcoins = US$540,388,962,000), representing about 71.47% of market capitalisation value for all cryptocurrencies (756.1 billion) during the period.

Fourth, individuals and organisations seeking to book hotel accommodations for leisure and business purposes could conclude such transactions on Expedia.com, Binance cryptocurrency exchange and other virtual exchanges using bitcoin. Fifth, institutions and families seeking to acquire furniture for offices and homes could finalise their transactions on Overstock.com and other virtual exchange platforms, using bitcoin. Sixth, parents and young adults interested in acquiring Xbox games and other products could purchase them, using bitcoins. Seventh, bitcoin is a strong substitute for credit cards; it makes local and international payments easy given that strings and regulations attached to banking activities are virtually non-existent in this case. Large, small- and medium-sized businesses could employ bitcoins in their transactions since they attract comparatively low fees and charges. Eighth, bitcoin facilitates trade and business within and among economies: individuals are able to conclude transactions with relative ease; necessary goods and services for trade purposes are obtained devoid of stringent foreign currency bottlenecks (Ashley, 2018).

Ninth, bitcoin serves as a major source of wealth creation for investors. Like gold, other valuable minerals and stable currencies, individuals invest in bitcoin with the expectation that it would surge in value to increase return on their investments (Ashley, 2018). As an example, suppose an investor bought 100 bitcoins when each was trading at US$32.00 in 2013. That is, 1BTC to US$32.00; and held on till when it was trading at 1BTC to US$29,053.17 in 2020. The investor could derive US$29,021.17 (US$29,053.17 – US$32.00 = US$29,021.17) from the investment in each bitcoin. In all, the investor would be US$2,902,117 (US$29,021.17 x 100 bitcoins = US$2,902,117) richer. With an initial investment of US$3,200 (US$32 x 100 bitcoins = US$3,200), the investor could earn US$2,905,317 (US$29,053.17 x 100 bitcoins = US$2,905,317) as total return on investment; and net return on investment of US$2,902,117 (US$2,905,317 - US$3,200 = US$2,902,117).

Finally, trading in bitcoin serves as a major source of investment; proceeds from investment in bitcoins could contribute to economic growth (Ashley, 2018). In our earlier example, a trader with an initial investment of US$3,200 in 2013 could be worth US$2,905,317 in 2020. Similarly, an investor who purchased 1,000 bitcoins when it traded at 1BTC to US$0.008 would have invested US$8.00 (US$0.008 x 1,000 bitcoins = US$8.00) at the initial investment date. In December 2020, the investor would be worth US$29,053,170 (US$29,053.17 x 1,000 bitcoins = US$29,053,170); the return on his or her investment would be US$2,291,098.40 (US$29,053,170 – US$8.00 = US$29,053,162). As pointed out by Licardo (2020), bitcoin has the potential of creating media and brand awareness for the selling company's brand while the latter makes strenuous efforts to market the former. Thus, bitcoin has the potential of creating a win-win situation for sellers and buyers in the global digital currency markets.

An investor could purchase a satoshi, which is a fraction of or purchase full bitcoin depending on his or her investment strength. Traders are not under obligation to buy a full bitcoin for investment or day-to-day transaction purposes. The foregoing implies, though a token of bitcoin was traded at US$29,053.17 on 31st December, 2020, an investor was at liberty to buy say, US$100, US$200, US$1,000 or US$20,000 worth of satoshi (a fraction of the bitcoin). Similarly, the investor was at liberty to purchase a full token at US$29,053.17 or in multiples, that is, two or more bitcoins. These investments could contribute significantly to the overall gross domestic product of the implied economies. The implication is an economy stands to benefit a great deal from successful

transactions in bitcoin and altcoins trading (Ashley, 2018). Thus, protection for virtual exchange platforms from nefarious activities of predatory hackers should not be the sole responsibility of virtual exchange operators; the responsibility must be extended to elected governments in global economies.

4.2 Challenges to the Investor Community

In spite of the numerous benefits, extant research (Sanger, 2012; Pagliery, 2013; Romm, 2018; Yellin et al.; Brown & Whittle, 2020) identified some challenges associated with adaption and use of bitcoin as a universal medium of exchange in the global financial and business markets. An immediate challenge identified relate to transactions' security in the virtual currency markets. A major setback introduced by improved technological standards to the global economy in the 21st century is system-hacks by sophisticated hijackers, which have the tendency to impact negatively on the investment fortunes of existing professional and amateur investors; and on potential investors in the global virtual currency markets. Classic examples were the attacks on Bitfinex's systems by hackers in 2016, resulting in loss of bitcoins valued at over US$10 million; and the cyber-attack on Coincheck, which resulted in loss of bitcoins worth more than US$530 million. The initial target for the eventual cyber-attack on Coincheck was NEM coins based in Singapore. In some cases, traders' bitcoins were fled with by some firms on the virtual exchanges. For instance, investigators into the cyber-attacks on Mt. Gox in Japan indicted the CEO of diverting valuable amount of bitcoins into private accounts (Kirk, 2016).

Yellin et al. (as cited in Ashley, 2018) revealed trading in bitcoins is carried out in a virtual environment. However, an investor's bitcoin wallet could be destroyed by a virus, or the investor may accidentally delete the information from the system. This "accidental" occurrence may lead to loss of total investment. Again, individuals with little or no knowledge in the use of computer and its related software may find it difficult to assure effective participation in virtual financial transactions. At best, potential investors with deficiency in the use of computers may rely on others with technological sophistry to conclude their transactions. This could lead to password disclosure to third parties and eventual depletion of an investor's total investment by the former.

Another major concern is the issue of anonymity in the virtual exchange markets. Holders of bitcoin accounts have the opportunity to buy goods and services on anonymity in some jurisdictions; buyers could purchase products without disclosing their identity. Original bitcoin transactions required only use of wallet identity numbers. This may sound refreshing to well-meaning traders who would like to conceal their identity in the Internet market space mainly due to security reasons. However, in times of theft, it may be difficult to trace the perpetrator or perpetrators for redress. Anonymity has made bitcoin exchanges appropriate hub for some individuals to engage in illicit activities, including drug purchases which hitherto, may not be sold to those buyers. Consequently, bitcoin exchanges promote the culture of substance abuse; the exchanges allow individuals to trade in socially unapproved substances. Some individuals hide behind the cloak of bitcoin account's anonymity to trade in child pornography, engage in sex trafficking; and to hire assassins, among other universally unapproved socio-business activities (Ashley, 2018).

Unlike bank accounts, investments in bitcoin are not backed or guaranteed by the central banks of most economies in which they are traded. In the United States of America, the Federal Deposit Insurance Corporation (FDIC) used to guarantee a standard refund limit of US$250,000 per FDIC-insured bank, and per category of ownership in times of liquidation of a bank. The FDIC insures deposits based on types of ownership and title of accounts held by depositors. In Ghana, no such amount has been predetermined. However, in times of liquidation, the Bank of Ghana intervenes as stipulated in the Bank of Ghana (Amendment) Act of 2016 (Act 918); and the Banks and

Specialised Deposit-Taking Institutions Act of 2016 (Act 930) to ensure amicable settlement of any financial impasse between the implied banks and their affected depositors; and to ensure confidence of the general public in the financial system is not waned (Ashley, 2018).

Opponents of cryptocurrencies and their related trading activities believed bitcoin exchanges serve as a "fertile" ground for terrorist groups to mobilise funds for their nefarious activities. Funding activities of Al-Qaida, Boko Haram, Islamic State in Syria (ISIS), terrorist groups in Iraq, Afghanistan, Pakistan, Libya, Mali, among others, have been a source of worry to the international community; funding the activities of terrorist groups clandestinely thwarts global efforts aimed at ensuring cease fire and promoting peace among countries across the globe. The ability to trade on grounds of anonymity stems the financial tide in favour of the terrorist groups. Stated in different terms, virtual currencies such as bitcoin afford some individuals and groups the opportunity to engage in money laundering and finance terrorism, financial transactions with widespread condemnation from most economies throughout the world (Ashley, 2018).

Tax evasion has been a major concern for elected governments of economies in which bitcoin and other cryptocurrencies are traded. As at the time of writing, the activities of bitcoin traders were not regulated directly by central banks in many economies. As a result, it was difficult for various economies, through their central banks, to determine effectively volumes of trade in bitcoins and the amount to be charged in taxes to support national activities. Indeed, the activities of bitcoin investors could boost economies through GDP growth, emanating from increased investments. However, direct tax revenue mobilisation by the governments may not be derived since investors are not under any direct obligation to pay taxes on their financial gains. Besides, governments have little or no control, over bitcoin and its related transactions (Ashley, 2018).

Inkoom (as cited in Ashley, 2018) noted globally, the following monetary aggregates are utilised by most economies: M_0, M_1, M_2, M_3, and others. The following monetary aggregates are used in Ghana: M_1, M_2, and M_{2+}. The Bank of Ghana describes M_1 as the money supply or narrow money. It consists of *currency with the public* (that is, currency outside the banking system) and demand deposits. In Kenya and many other economic jurisdictions, definition of M_1 includes time deposits. M_2 is described by the Bank of Ghana as the total liquidity or broad money. It includes M_1 *plus quasi-money* which comprises savings deposit, time deposits, and certificates of deposit with the deposit-money banks (DMBs). M_{2+} is the broader definition of money; it comprises M_2 *plus foreign currency*. Foreign currency is denoted by (+). Ghana uses M_1, M_2, and M_{2+} to target her macro-economic objectives.

One of the numerous efforts geared toward strengthening and improving the financial sub-sector's contribution to GDP growth is encouraging the general public to increase the aggregation of money that passes through the banking system. That is, discouraging the growth of M_1 monetary aggregate in the financial system. Evidently, the prevailing bitcoin system does not support the foregoing cause; bitcoin transactions do not require middlemen – no banks are required to initiate and finalise transactions – this affects the volume of money that passes through the banking system (Ashley, 2018). However, the foregoing economic challenge persists because financial regulators in many countries are reluctant to officially recognise and issue licence to virtual exchange operators.

Stalnaker (as cited in Ashley, 2018) revealed the world's largest bitcoin exchange is located in China. Also, Baidu, one of the largest Internet firms in the world, is incorporated in China. Baidu, Incorporated integrates and uses bitcoin. Though refreshing news to the People's Republic of China, there are dire financial implications for other countries across the globe. For instance, should ownership of the largest bitcoin exchange translate into highest share in bitcoin ownership (say,

50.1% or more), China stands the chance of influencing bitcoin-related transactions and controlling the cryptocurrency industry across the globe.

Ashley (2018) noted **v**alue of the Chinese renminbi relative to the American dollar is low. However, holding large volumes of bitcoin would help China to reduce the value of American dollars in her possession; fewer bitcoins would be required to pay off huge amounts in American dollars. Similarly, strong stakes in bitcoin would allow China to exert economic influence in Africa; China could purchase more commodities from Africa at relatively cheaper prices due to the value of bitcoin. Thus, African and other continents' economies stand to lose a great deal from China's strong interest in digital currencies. To get even on economic gains from bitcoin and altcoins transactions, other countries spread across the various continents must equally develop strong interest in the operations of the global cryptocurrency markets.

Sporadic surge in value of bitcoin and other digital currencies could worsen the plight of already-weak currencies of some economies on the African and other continents. As at 31st December, 2020, a token of bitcoin was traded at US$29,053.17. The implication is the United States may face challenges in concluding oil contracts with oil-producing countries that have no membership in the Organisation of Petroleum Exporting Countries (OPEC); and denominate their crude oil prices in bitcoin: more dollars would be required to pay for the same number of barrels of crude oil with prices quoted in bitcoins (Ashley, 2018).

The research revealed regulation of decentralised systems may be difficult to achieve unless the desired regulation is built into the source code of the implied decentralised systems. Salami (2020a) believed to realise this objective, regulators would have to co-operate with developers of blockchain software in the virtual currency industry. However, a major challenge to this approach is the tendency to cede too much power to system developers, which could lead to manipulation of system-codes to circumvent regulatory oversights with convenience by developers. Thus, instead of choosing to co-operate with system-developers, Salami (2020a) argued regulators would be better-off with an option to ban unregulated virtual financial trading activities.

However, the decision to ban or shut down decentralised systems in the cryptocurrency industry may be a daunting task, if not impossible. This notwithstanding, Salami (2020a) catalogued possible steps that could be taken to achieve this objective: access to IP addresses, co-operation with Internet service providers in the localities, heavy reliance on national regulatory authorities, identification or trace of physical location of system-users, and use of the police to effectively shut down the activities or platforms. These identified steps are expected to discourage potentials who hitherto, employed the digital systems for illicit trading activities, albeit difficult to achieve on a universal scale. Besides, complexity of the decentralised systems of virtual exchanges makes the location and prosecution of any virtual exchange within a jurisdiction quite challenging.

4.3 Regulatory Measures on Cryptocurrencies

Discussion in the preceding section affirmed, transactions of bitcoin and other cryptocurrencies were mostly unregulated. However, the trend has reversed or improved in recent years. The anti-money laundering (AML) and counter terrorism financing watchdog for the global community, Financial Actions Task Force (FATF), has set rules for the cryptocurrency industry. FATF rules are essentially restricted to centralised systems such as cryptocurrency exchange markets, which are duly licenced to allow investors trade their digital tokens for other assets, including fiat currencies such as the American dollar, European euro, and British pound sterling. FATF has outlined "know your customer (KYC)" requirements for all the licenced virtual exchanges. The know-your-customer requirements set out by the Financial Actions Task Force seeks to establish the identity of

traders (buyers and sellers) on the various platforms. The requirements affirm the need for each virtual exchange to establish the identity of parties to a transaction on its platform. These new global standards, including KYC rules were not part of previous regulations; and this explains why some countries were hesitant to approve of cryptocurrency transactions in their jurisdictions in prior and recent years (Salami, 2020b).

Unfortunately, FATF rules are not directly applicable to decentralised systems and their related financial activities. Stated in different words, FATF rules are not expected to regulate directly the activities of buyers and sellers in decentralised systems to help curb the high incidence of fraud and anti-money laundering activities associated thereof. The high level of anonymity makes decentralised virtual exchange systems strong vehicles for promotion of anti-money laundering and other illicit activities on a global scale. Limitations in the FATF rules attenuate the effectiveness of its regulations; and place enormous responsibilities on individual economies to institute measures that would provide the necessary shelter for investors in their respective jurisdictions.

Admittedly, the global traditional financial infrastructure has had challenges with control of the "new-order" introduced by the digital financial markets. And because regulators have been behind the curve, investors in the virtual currency markets have flourished in the vacuum (Cheah, 2020). Nevertheless, the traditional system has succeeded in derailing efforts of the new system with bureaucratic processes. However, the new paradigm and constant introduction of innovative technologies make it quite herculean for a united regulatory front to be achieved at the global level. Paradoxically, lack of approval and meaningful adoption of cryptocurrencies as medium of exchange at the global level could be attributed to the absence of uniform regulations at the global level (Brown and Whittle, 2020).

The research revealed countries that hitherto placed ban on cryptocurrencies and refused to recognise same as a medium of exchange were beginning to whet their financial appetite with crypto assets; cryptocurrencies had begun to gain recognition in the financial laws and courts of these economies. This sudden shift in financial goal post is likely to draw cryptocurrencies into the mainstream global financial system (Salami, 2020b). Ripple has gained popularity and recognition among governments and large banks in many countries due to its effectiveness (The European Business Review, 2020).

So far, the following selected economies across the globe have considered and adapted regulations to forestall any financial tsunami by the digital financial exchanges on individual and corporate investors: Australia, Canada, China, European Union (EU) and the United Kingdom (UK), Ghana, India, Japan, Nigeria, Russia and Belarus, Singapore, South Africa, South Korea, Switzerland, United Arab Emirates (UAE), United States of America (USA), Venezuela and Zimbabwe, among others. A common belief held among these economies is the urgent need for them to take proactive steps to protect the investment purse of their citizens and foreign investors in their respective jurisdictions. This initiative is expected to improve the issue of lack of effective control over the activities of traders in bitcoin and other cryptocurrencies in the virtual currency markets. Brown and Whittle (2020) noted individual economies have been late in their respective responses to the challenges posed by the global cryptocurrency industry. However, their "late" responses have been dramatic and powerful. The following section presents brief explanation on regulatory measures adapted by each of the above-listed economies.

4.3.1 Australia

Ashley (2018) indicated in 2015, the Australian government decided to adapt a *hands-off* approach to the regulation of cryptocurrencies in the country. However, in August 2017, the Commonwealth

Bank of Australia was saddled with a financial scandal. This compelled the Australian government to revise her initial stance from hands-off approach to adaption of more stringent rules to regulate digital currency and anti-money laundering as pertained in other global jurisdictions including Japan. The following statement affirmed the position of the Australian Taxation Office (ATO) on bitcoin:

> Transacting with bitcoin is akin to a barter arrangement, with similar tax consequences. Our view is that bitcoin is neither money nor a foreign currency, and the supply of bitcoin is not a financial supply for goods and services tax (GST) purposes. Bitcoin is, however, an asset for capital gains tax (CGT) purposes. (ATO as cited in Nelson, 2018, para. 25)

Contrary to the stance of the Australian Taxation Office, lawmakers from the Labour and Coalition Parties, the two leading political parties in Australia, called on the Reserve Bank of Australia (RBA) to accept cryptocurrencies as an official form of currency. Australia lacked clear-cut policies on cryptocurrency, and this had adverse effects on performance of the economy towards the end of 2017: Australian cryptocurrency brokers stopped making deposits in Australian dollars **(**Ashley, 2018).

Australia has become a target for cyber-attacks in recent years. In early 2019, the Australian Parliament network was compromised by system-hackers. Later in February 2019, computer networks of major political parties in Australia were hijacked. The relative short intervals highlighted the enormity of threat posed by the cyber-attacks to state-machinery and the nation as a whole. The Australian Prime Minister, Mr. Scott Morrison, attributed the series of cyber-attacks to a "sophisticated state actor" (Finlay & Payne, 2019, para. 1). The frequency of attacks on state infrastructure compelled some analysts to describe the spate of cyber-attacks on Australia as the "new normal" (Finlay & Payne, 2019, para. 3).

In June 2020, Prime Minister Morrison announced new threats of cyber-attacks on his country. Prime Minister Morrison noted Australian businesses and government agencies were the main targets. He described the attack as "state-sponsored," without making specific reference to any sovereign country. To curb threats of the cyber-attacks, Prime Minister Morrison called on Australian businesses to use available government resources, look-out for spam, beware of distributed denial of service attacks, and have back-up plan, among other security measures (Elkhodr, 2020). In addition to the foregoing, the Australian government took steps to defend the country from incessant attacks. Some of the measures rolled-out included augmenting the staff-capacity of the Australian Signals Directorate by 500 employees; and increasing its funding by A$1.3 billion. Further, Australia's 2020 Cyber Security Strategy was expected to include strategies to proactively improve digital literacy and cyber security (Leins, 2020).

4.3.2 Canada

Canada holds an enviable record in the world of digital currency: it is the first country in the world to enact a national law on digital currencies. On 19th June, 2014, the Canadian Parliament approved Bill C-31 on digital currencies after weeks of several hearings and testimonies by key stakeholders. The Financial Consumer Agency (FCA) in Canada does not accept digital currencies as a *legal tender*, save Canadian bank notes and coins. Nelson (as cited in Ashley, 2018) described Canada as the most transparent country with the exception of Switzerland, when it comes to understanding and appreciating laws related to cryptocurrency trading.

Generally, authorities in Canada are not strict on digital currency regulations; periodic regulatory requirements and guidance are issued to facilitate the activities of traders and investors in the digital currency markets. For instance, on 24th August, 2017, the Canadian Securities Administration

(CSA) released regulatory notice on the potentials of applying Canadian securities laws to digital currencies. The CSA released regulatory notice on digital currency trading and marketplace operations; and provided participants in the digital currency market with guidance on how to effectively analyse the regulatory requirements (Nelson as cited in Ashley, 2018).

Some key stakeholders in Canada expressed misgivings about use of the term, cryptocurrency. As an example, on 25th January, 2018, Mr. Stephen Poloz, Head of the Central Bank of Canada, expressed his objection to use of the term, cryptocurrency. He argued cryptocurrencies are *crypto*, but not currencies; cryptocurrencies have no intrinsic value and could therefore, not be analysed as assets; they could at best be described as securities. Canada is an official member of the North American Securities Administrators Association (NASAA), which believes the risk of fraud associated with trading in digital currencies is high (Nelson as cited in Ashley, 2018).

However, the Canadian laws on cryptocurrency allow for bitcoin and altcoins to be used in payments for goods and services; the virtual currencies are recognised as a commodity, but not a legal tender. Canadian businesses that accept bitcoin and altcoins as payments for goods and services are required by the state tax laws to include the transaction amounts in their respective incomes for tax-reporting purposes. Further, the laws regulating cryptocurrencies including bitcoin allow for mining of the virtual currencies in the country. Individuals are at liberty to mine bitcoin and other cryptocurrencies in commercial quantities, or as a hobby. Earnings from mining virtual currencies in commercial quantities would have to be reported for tax purposes. However, individuals who mine cryptocurrencies for fun or as hobby are not obliged to report their activities for tax purposes (Loc.gov. 2020).

4.3.3 China

Stalnaker (2013) and Nelson (2018) reported that adaption and implementation of cryptocurrency in China increased significantly in 2017. In the said year, adaption of digital currencies in China was higher than recorded in any other country across the globe. Bitcoin miners in China constituted over 50% of the total bitcoin mining population throughout the world in 2017. However, in the midst of the sporadic surge in digital currency trading, the Chinese government was strongly committed to weeding out corruption and discouraging capital flights.

As part of measures aimed at achieving the foregoing objectives, the Chinese government, in January 2018, introduced strict rules to regulate cryptocurrency operations in the country. For instance, there was a ban on initial coin offerings (ICOs); all bank accounts related to cryptocurrency exchanges were frozen; bitcoin miners were prevented from continuing with their activities; and nationwide ban on mobile and Internet access to all cryptocurrency-related activities and transactions were implemented. The sudden change in stance related to cryptocurrency operations in China during the period surprised many digital currency analysts (Ashley, 2018).

However, the surprise among analysts was assuaged by the fact that these measures were adopted strategically by the Chinese government to resolve important economic issues. That is, to stamp-out corruption and discourage capital flights. During the current research period, the Chinese government was leading a comity of advanced economies in the “official” recognition and implementation of digital currency-related activities at the national level. The Chinese government had created a digital coin known as ***digital renminbi*** which was operational on a pilot basis. Operations of digital renminbi are entrusted to the Chinese central bank called the People’s Bank of China. There were speculations of digital networks convergence. For instance, it was believed the digital currency electronic payments system operated by China would have some form of support for ethereum applications. Holders of PayPal accounts in the United States have the opportunity to

purchase bitcoin through their respective PayPal accounts, but unable to effect payments with bitcoin. However, operators of the PayPal system affirmed their commitment to enable PayPal payments with bitcoin effective 2021 (Potts & Rennie, 2020; Brown and Whittle, 2020).

4.3.4 European Union and the United Kingdom

Nelson (as cited in Ashley, 2018) reported as of 2018, the European Union, just like the United Kingdom, had not presented final legislation on digital currencies and their related activities. However, the European Union and the United Kingdom had demonstrated strong commitment to the adaption of rules to regulate digital currencies. Regulatory initiatives by the two bodies included report of suspicious activities while due diligence is effectively conducted on traders in the cryptocurrency markets. Like South Korea, the European Union and the United Kingdom were seeking to end anonymity for digital currency traders to curb tax evasion and money laundering, among other legally unapproved financial transactions.

On 18th December, 2017, Mr. Pierre Moscovici, the European Union Commissioner, stated the European Union's unpreparedness to regulate bitcoin and altcoins. However, on 20th December, 2017 Vice President of the European Commission, Mr. Valdis Dombrovskis, noted price volatility of bitcoins exposed consumers and investors to risk such as liability gaps, market manipulation, operational and security failures, and complete loss of investment. Although there was little evidence to suggest use of digital currencies in money laundering, the United Kingdom, through its Treasury, began negotiations to allow the inclusion of some wallet providers; and platforms of digital currency exchanges in regulation related to counter-terrorism financing and anti-money laundering (Ashley, 2018). The European Union recently proposed enactment of the *Markets in Crypto-Assets (MiCA) Regulation* for implementation in its jurisdiction. Some analysts in the virtual financial markets argued contents of the proposed legislation on virtual currencies including bitcoin by the European Union could potentially harm the operations, fortunes and success of some investment funds management firms in the digital currency markets.

Mr. Bruno Le Maire, the French Economic Minister, announced his country's resolve to create a working group to regulate cryptocurrencies. Also, a Board Member of the German Bundesbank, Mr. Joachim Wuermeling, suggested the need for effective regulation of cryptocurrencies at the global level (Ashley, 2018). On 26th February, 2020, judgement by a court in France described a loan involving bitcoin as a consumer loan. This ruling placed bitcoin in the category of legal tender and other financial assets in France. It was the first time bitcoin was upheld and recognised; and this reassured cryptocurrency traders of equal protection under the financial laws in France. In a related development, on 2nd March, 2020, the financial regulator in Germany, Federal Financial Services Authority (BaFin), amended its existing legislation on virtual assets to align with the Financial Actions Task Force standards (Salami, 2020b).

On 22nd January, 2018, Mr. Dombrovskis predicted a bubble in bitcoin trading. And on 25th January, 2018, former Prime Minister of the United Kingdom, Madam Theresa May, called for a serious look at the cryptocurrency markets since they could serve as a safe financial "haven" for criminals. Prime Minister May's clarion call was made when plans were far advanced to ensure the exit of Britain (known as Brexit) from the European Union by March 2019, although the exit was extended to and implemented on 31st January, 2020. However, the Brexit arrangements had no effect on the collaborative efforts of the two aimed at clamping down on the activities of cryptocurrency traders, which decelerate economic development and growth (Nelson as cited in Ashley, 2018).

Recent findings shared by the Cambridge University (as cited in Brown, 2020) revealed most businesses in the cryptocurrency industry were operating without licences. As part of measures and efforts to clamp-down on unapproved activities on the virtual exchanges, the *Financial Conduct Authority (FCA)* in the United Kingdom announced ban on sale and promotion of derivatives of bitcoin and altcoins to non-professional or inexperienced investors. FCA is the financial regulator in the United Kingdom. Brown (2020) described FCA's initiative as a big blow to the growing virtual exchange markets. However, the foregoing initiative of the UK government was not intended to discourage or harm trading in bitcoins and other cryptocurrencies, but to ensure both amateur and professional actors in the virtual exchange markets are provided with the necessary protection to assure safety of their investments while minimising eventual blame by these investors on the government.

In the United Kingdom, rules adapted by the Financial Conduct Authority for implementation could deny retail investors in the cryptocurrency industry the opportunity to buy and sell cryptocurrency options and futures. Some investors in the virtual currency markets use cryptocurrency options and futures to hedge their bets on underlying assets, which is consistent with one of the recommendations in Ashley (2018). To illustrate, an investor in the virtual currency market may decide to purchase an option to sell an X number of bitcoins at a pre-determined price (US$28,600.00 per unit), should there be a fall in the initial price (US$28,500.00) by say 5% (US$1,425.00). Thus, the option provides the investor the necessary insurance cover against volatilities, especially price falls, in the virtual exchange markets. The tendency to place a bet or hedge on the fluctuating prices of bitcoins and other cryptocurrencies is known as *index option* (Ashley, 2013, p.99).

Ban on use of cryptocurrency options and futures as strategic investment hedges in the United Kingdom was expected to take effect from 6th January, 2021. The Financial Conduct Authority argued valuation of bitcoin and altcoins has no reliable basis. To this end, the ban was necessary to protect inexperienced investors against the risk of losses that could best be described as sudden and unexpected; and which could occur through *investment sensationalism*. That is, the likelihood of inexperienced investors believing every news-headline about the current and future prospects of cryptocurrencies, and investing all their savings therein. FCA (as cited in Brown, 2020) argued inexperienced investors have limited understanding of happenings in the virtual currency exchanges which are often characterised by financial crime, market abuse, and high volatility; and which affect effective measurement of market capitalisation values for bitcoin and altcoins.

Effective implementation of FCA's rules may suffer a setback, especially when investors have the opportunity to trade on virtual exchanges not located in the UK; and not under the jurisdiction of the Financial Conduct Authority. A significant observation during the research period was FCA's ban was not extended to hedge fund institutions and professional traders; these categories of investors are allowed to access riskier financial products than the general population owing to the former's level of expertise and understanding of the financial markets. However, it is worth-mentioning Brown's (2020) interactions with some retail investors revealed their in-depth knowledge and understanding of the art of bitcoin and altcoins trading than some of the licenced financial institutions, albeit there were many other retail investors with limited knowledge about the level of risk assumed in their respective investments, implying the ban was necessary. Investor-losses to be prevented by the FCA rules were estimated between £19 million and £101 million.

4.3.5 Ghana

Nelson (as cited in Ashley, 2018) revealed on 22nd January, 2018 the Governor of the Bank of Ghana, Dr. Ernest Addison, held a press briefing in Accra, the nation's capital, to state the position

of the Ghanaian government on bitcoin. Dr. Addison was categorical on the country's position at the press briefing: "Bitcoin is not yet a legal tender." A Bill on cryptocurrency trading has already been laid before the Parliament of Ghana. Content of the proposed Bill sought among other things, to regulate use of digital currencies in the Ghanaian economy. Until the Bill is passed, cryptocurrencies, including bitcoins, are not recognised as a legal tender in Ghana. Prior to the Bank of Ghana's statement, Groupe Ndoum, one of the investment institutions in Ghana, suggested the need for Bank of Ghana to consider investing 1% of its reserves in bitcoin.

The Bank of Ghana Act of 2002, Act 612, Section 4, Sub-sections (1) (d) and (e); and the Banking Act of 2004, Act 673, Section 51, Sub-sections (a) (3) allow the Bank of Ghana to regulate transactions concluded on mobile phones and related electronic devices. The operations of bitcoin and other cryptocurrencies are likely to be considered under the Payment System Act of 2003, Act 662, which mandates the Bank of Ghana to ensure promotion and supervision of electronic and other payments; and transfer of funds, clearing, and settlement systems (PWC as cited in Ashley, 2018).

Owusu (2020) averred bitcoin and altcoins trading in Ghana has become a thorny issue among regulators; and this has affected the understanding of the general public in laws regulating virtual currency trading in the country. The imminent question posed by many investors and admirers of cryptocurrency trading is whether or not bitcoin and altcoins trading in Ghana remains legal or illegal. In response to the foregoing question, Owusu (2020) maintained there are no clear-cut laws regulating bitcoin and altcoins trading. Stated differently, trading in bitcoin and other cryptocurrencies in Ghana is neither legal nor illegal; there are no definitive regulatory frameworks in place to guide the activities of virtual exchange operators and investors, albeit the Bank of Ghana (BoG) assumes the role of financial regulator with the Securities and Exchange Commission (SEC) playing a supporting role. Both the Bank of Ghana and Securities and Exchange Commission have issued statements on blockchain technology and virtual currency trading over the years. However, they are yet to present implementable regulatory framework on cryptocurrency trading in the country.

Final legislations on bitcoin and other cryptocurrencies could determine the "main" regulatory body in Ghana. Suppose bitcoin and altcoins are categorised solely as commodities in the proposed Bill to the Parliament of Ghana. When passed into law, cryptocurrencies would fall under direct supervision of the Securities and Exchange Commission which has oversight responsibilities over securities and investment companies in the country. In this case, the Bank of Ghana would assume a complementary role in the regulatory process. However, should the Bill recognise bitcoin and altcoins solely as medium of payment for transactions, the supervision may fall under the purview of the Bank of Ghana; and SEC would assume a supporting role in the regulatory process. Further, should the proposed Bill recognise bitcoin and altcoins as both commodity and medium of payment for goods and services, SEC and the Bank of Ghana would assume regulatory roles concurrently. Even when bitcoin and altcoins are recognised solely as commodity, role of the Bank of Ghana in the regulatory process may extend beyond complementary, especially when the enacted laws make it possible for virtual exchange operators to transact business with banks in the country.

As of the research date, the Bank of Ghana was yet to activate bitcoin and altcoins trading under the Payment System Act of 2003, Act 662 or any other Act. As a caveat, the Bank of Ghana reminded the general public of non-activation of Act 662 to include bitcoin and altcoins trading while the Securities and Exchange Commission maintained investors' decision to trade and invest in cryptocurrencies is at their own risk. SEC emphasised that under the current dispensation, bitcoin and other cryptocurrencies are neither legal tender nor currency in Ghana. The securities law regime

in the country did not provide protection for investments in cryptocurrencies and crypto-assets during the research period.

4.3.6 India

Nelson (as cited in Ashley, 2018), noted many economic experts and financial analysts describe the Republic of India as a cash-reliant economy. That is, most business transactions are concluded on cash basis. However, the craving for digital currency trading assumed a greater dimension in the Indian economy until early 2018 when the government introduced more stringent regulatory measures to clamp-down on the activities of traders.

The Indian government argued the digital currency markets are fertile grounds for tax evasion, proliferation of illegal activities, and sponsoring of terrorist activities, among others. These notwithstanding, digital currency traders in the domestic Indian economy did not believe the more stringent rules adapted earlier by the Chinese government would be replicated by the Indian government (Ashley, 2018). In April 2018, financial institutions in India were banned from engaging in direct transactions with virtual currency firms by the central bank. A notification issued by the Reserve Bank of India (RBI) banned financial institutions and banks under its supervision from providing services to clients and non-clients transactions related to cryptocurrencies. Repeated warnings on dangers of investing in cryptocurrencies were issued by the Reserve Bank of India to the investor community and the general public (Anand, Dusad & Patel, 2020). However, on 10th March, 2020, the ban was overturned by the Supreme Court (Salami, 2020b).

Conversely, as of October 2020, cryptocurrency trading activities in India were not regulated. In spite of this hands-off approach, investors were prohibited from trading in cryptocurrencies including bitcoin; the Indian government and Reserve Bank of India had imposed ban on dealing in cryptocurrencies. The Reserve Bank of India described cryptocurrencies as "stateless digital currencies" (Anand et al., 2020, para. 8) with minimal level of traceability. Salami (2020b) noted a drastic reduction in the use of cryptocurrencies in India, prior to the Supreme Court's ruling, meaning pessimism of investors in the potentials of trading in cryptocurrencies remained high owing perhaps, to the caveats issued by the financial regulator and the Indian government.

4.3.7 Japan

Nelson (as cited in Ashley, 2018) revealed regulatory measures on cryptocurrency in Japan were neither stringent nor liberal; the country appeared to be more receptive to the activities of cryptocurrency operators than its neighbours including china and South Korea. Japan was believed to be the investment hub of cryptocurrency operators who found regulatory measures in other Asian countries hostile and unfriendly. As of 2018, plans were underway in Japan to introduce a cryptocurrency awareness campaign group known as the *J-pop band*. However, it was uncertain if the Japanese government would approve of the activities of this novel digital currency awareness campaign group. Fortunately, the objective of founders of the J-pop band was achieved; marketing of digital currencies through concerts by the J-pop band was not inhibited by the Japanese government; and the band was widely-acclaimed and accepted by the Japanese people.

Japanese name for the J-pop band is *Kasotsuka Shojo*, which means *Virtual Currency Girls* (Ong, 2018, para. 2). The band is made up of eight girls, each of whom represents different cryptocurrency such as bitcoin, ethereum, ripple and cardano, among others. The custom-made hat of each of the girls in the band represents a cryptocurrency. A press statement issued by the group's leader, Rara Nause (as cited in Ong, 2018), noted the group's intention to "promote the idea through

entertainment that virtual currencies are not just a tool for speculation but are a wonderful technology that would shape the future" (para. 3).

In April 2017, Japan enacted laws that recognised bitcoin as a legal tender. This notwithstanding, the Japanese interest in cryptocurrencies suffered a setback, following the predatory hack on 26th January, 2018 of a Japanese exchange, resulting in the loss of about US$530 million worth of NEM coins. This development raised public uproar and the need for the Japanese Financial Services Agency (FSA) to ensure close supervision on digital currency trading in the country. Concerns expressed by the investor-community in Japan were legitimate since Ong (2018) revealed cryptocurrency trades in Japan account for about half of trade volume at the global level.

4.3.8 Nigeria

Nigeria remains Africa's largest economy with a gross domestic product of US$448.10 billion in 2019 (Trading Economics, 2020). In 2017, the Nigerian economy went through recession leading to a fall in value of her local currency, naira. To stem the tide of the crumbling economy, the Nigerian government restricted traders' access to the American dollar. This compelled businessmen and women in the country to seek financial refuge in bitcoin and other cryptocurrencies (Ashley, 2018).

Act 2007 of the Central Bank of Nigeria (CBN) affirmed the exclusive rights of the Central Bank to issue legal tenders of any kind in Nigeria. The Act bars other persons and authorities from issuing tokens which are likely to pass as legal tender in the country. Pursuant to the foregoing, on 12th January 2017, the Central Bank of Nigeria decided to apply strict rules and regulation to use of the digital currency; and a circular was issued to that effect. It was argued that non-traceability of cryptocurrencies including bitcoin renders them highly susceptible to manipulation and abuse by terrorists and criminals. The foregoing possibilities and consequential effects underscored the need for integrity of the financial system in Nigeria to be protected (Aelex.com, 2020). However, this decision was later rescinded; Mr. Musa Itopa Jimoh, Deputy Governor of the Central Bank of Nigeria, noted CBN did not have the locus to regulate or control bitcoins, blockchain or the Internet since the country does not own any of them. In Nigeria, trading in bitcoin surged by 1,500% in 2017 (Nelson as cited in Ashley, 2018).

On 25th January, 2018, Mr. Edwin Emefiele, Governor of the Central Bank of Nigeria, renewed the government's commitment to regulating digital currency trading. The Governor likened investment in digital currencies to gambling and that, the Nigerian government could not support instances where individuals and group of investors alike, risk their savings to gamble. However, the unimpressive performance of the Nigerian economy in 2017 posed a challenge to successful implementation of any legislation seeking to regulate digital currency trading in the country during the period (Nelson as cited in Ashley, 2018).

Pending the release of final legislation to guide use of virtual currencies, the Central Bank of Nigeria advised financial institutions including banks not to transact, hold or trade in any way with bitcoins and altcoins. Further, traders on the various virtual exchanges must ensure strict compliance with the relevant laws on combating the finance of terrorism (CFT) and anti-money laundering. Also, financial institutions including banks that are not satisfied with the framework on combating the finance of terrorism and anti-money laundering of virtual exchange operators and virtual currency customers could discontinue with their relationship. Moreover, the Central Bank of Nigeria reiterated its stance on cryptocurrencies: bitcoin and altcoins are not a legal tender. Consequently, anyone who uses or transacts business with them does so at his or her own risk (Aelex.com, 2020). The foregoing suggests the official position of Ghana and Nigeria on cryptocurrencies is not distinct. However, discussion in the following section indicates caveats by

financial regulators in Nigeria have had little impact on control of cryptocurrencies trading in the country.

The Investment and Securities Act of 2007 and the Rules and Regulations of the Securities and Exchange Commission provide the regulatory framework for securities in Nigeria. In 2017, the Securities and Exchange Commission responsible for regulating securities and investments noted non-authorisation of firms and individuals engaged in cryptocurrency trading in Nigeria; and warned the general public of the dangers involved in trading in virtual currencies. In the midst of these caveats, regulators in Nigeria were keen on emerging with comprehensive legislation that could guide the activities of virtual currency trading and related activities in the country. In 2019, the *Fintech Roadmap Committee* was established by the Securities and Exchange Commission. Part of the Committee's findings focused on regulation of virtual currencies and virtual financial assets. Based on its findings, the Committee recommended the need for virtual currencies to be categorised into securities or commodities under the existing regulations of the Securities and Exchange Commission. The Committee's report urged SEC to work assiduously to emerge with a regulatory framework for the virtual currency market in Nigeria (Aelex.com, 2020).

The investor-population engaged in cryptocurrency trading in Nigeria is high, in spite of the absence of clear-cut regulatory framework to guide and protect investors from the risk inherent in the trade. Statistics released by Coin Market Cap, Bitcoin.com and Binance, among others (as cited in Aelex.com, 2020), paid glowing tribute to the virtual financial market in Nigeria. Coin Market Cap has a platform for tracking prices of virtual currencies. Its report (as cited in Aelex.com, 2020) suggested tracking of prices for cryptocurrencies in Nigeria increased to 211% while Bitcoin.com reported 11% of connected Nigerians use virtual currencies. Binance research affirmed growing interest in virtual currencies and Nigeria's leadership among countries with increasing interest in virtual currencies. Apps and exchange platforms related to virtual currencies are on the rise with Buycoins processing over five hundred million naira (N500 million) worth of virtual currencies in three months. The increasing taste for cryptocurrencies' usage in Nigeria could be attributed mainly to their role in facilitating payments and transfers in international transactions (Aelex.com, 2020).

4.3.9 Russia and Belarus

Prior to September 2017, the Russian Federation adapted a soft stance which allowed "qualified investors" to trade in digital currencies. In September 2017, Head of the Central Bank of Russia, Elvira Nabiullina, announced the central bank's unpreparedness to regulate digital currencies as a medium of payment for goods and services. The head noted the central bank was equally not prepared to regulate digital currencies as a foreign currency equivalent. These statements assured investors of a progressive hands-off approach to the regulation of the digital currency market in Russia (Nelson as cited in Ashley, 2018).

However, pronouncements by the Head of the Central Bank of the Russian Federation was short-lived on 8th September, 2017 when Mr. Alexei Moiseev, the Russian Federation's Deputy Finance Minister, disclosed at a Moscow Financial Forum that use of virtual currencies as a medium of payment is not yet legal in Russia. He noted the existence of a legal vacuum, which requires redress to affirm the status of virtual currencies in the Russian economy. On 11th October, 2017, the stance of the Deputy Finance Minister of the Russian Federation was corroborated by President Vladimir Putin when he catalogued potential risks associated with cryptocurrencies. He described digital currencies as avenue for tax evasion and spreading of fraudulent schemes; a hub for financial laundering and funding of terrorism activities; and conduit for possible victimisation of Russian nationals, among other harmful effects (Ashley, 2018).

The Finance Ministry in the Russian Federation, on 28th December, 2017, outlined some regulatory measures, including taxation on digital currency ventures. Again, on 11th January, 2018, President Vladimir Putin supported this call by affirming the need for regulatory measures for the digital currency market in the near future. However, President Vladimir Putin acknowledged the prerogative powers of the Central Bank in the administration of cryptocurrencies until new and strict legislations were introduced to regulate the virtual financial market in the country (Ashley, 2018).

A draft law on *Digital Financial Assets* was published by the Finance Ministry of the Russian Federation on 25th January, 2018. The final version of the law was expected to establish clearly procedures for initial coin offerings; affirm the legal regimes for digital currencies and mining; and to provide clear definition for tokens. However, political opponents in the Russian Federation such as Mr. Boris Titov described the draft law as excessively strict; and tougher than proposed legislations in countries such as Armenia, Belarus, Japan and Switzerland. Mr. Titov believed the Russian Federation would be better off not adapting anything than to implement such legislation (Nelson as cited in Ashley, 2018). Like the G5 Banks including the Bank of England, United States Federal Reserve, Bank of Japan, European Union Bank and Bank of Switzerland, the Russian Federation has already taken steps to launch her digital currency in the not-too-distant future (Brown and Whittle, 2020).

In December 2017, Belarus introduced legislation on cryptocurrencies called the *Digital Economy Development Ordinance*. The content of the Belarusian legislation was more investor-friendly than the legislation proposed by the Russian Federation. As a result, some officials of the Russian Federation including Mr. Alexei Moiseev believed the implementation of stringent legislation on the cryptocurrency industry may result in capital flight from Russia to neighbouring economies such as Belarus (Ashley, 2018).

4.3.10 Singapore

A report by Nelson (as cited in Ashley, 2018) revealed in December 2017, traders in virtual currencies were warned of the dangers of speculating in the digital currency markets, especially when the price of bitcoin was at its peak. The warning was issued by the Monetary Authority of Singapore (MAS). As noted earlier, on 26th January, 2018, the system of Coincheck, a Japanese virtual exchange, was hacked into by predators and $530 million worth of investment was lost to the hackers. It was believed the hackers' initial target was NEM coins based in Singapore. These challenges notwithstanding, authorities in Singapore were hopeful of the successful development of the virtual currency market, if the necessary checks and balances were effectively put in place. The authorities in Singapore believed with the current wave of strong regulations across the globe, a meltdown of the digital currency market as witnessed in the case of Lehman Brothers is quite remote.

Tharman Shanmugaratnam, the Singaporean Deputy Prime Minister, believed existing laws in the country did not make clear distinctions between transactions that are completed using digital currency, fiat currency or "other novel ways of transmitting value." The foregoing statement suggests the acceptance of digital currencies such as bitcoin as a legal tender in the Singaporean economy. On 28th January, 2020, the Payment Services Act (PSA) came into force in Singapore. The act, inter alia, requires businesses trading in virtual currencies to secure licence from the Monetary Authority of Singapore to ensure effective compliance with regulations related to anti-money laundering, and others. The licence requirements extend to all businesses that transfer virtual currencies within Singapore and outside the country to other jurisdictions (6AMLD Report, n.d.).

New regulations proposed by the Monetary Authority of Singapore in July 2020 were expected to have significant impact on the cryptocurrency industry. This followed earlier warning issued by MAS in January 2018 to Singaporeans on the dangers of investing in cryptocurrencies. Some financial analysts described the move by the Monetary Authority of Singapore as a step in the right direction; the initiative has the tendency to clamp-down on virtual currency operating firms whose activities have the tendency to increase risk inherent in cryptocurrency trading (6AMLD Report, n.d.).

4.3.11 South Africa

Over the past decade, the South African rand has been a financial victim of several devaluations by successive governments. Strong economic ties between South Africa and China seem to have an effect on their respective currencies; the Chinese renminbi has a direct relationship with the South African rand. For instance, a devaluation exercise by the South African government in 2015 resulted in about 26% drop in value of the rand with a corresponding 2% drop in the value of the renminbi (Ashley, 2018).

Nelson (as cited in Ashley, 2018) shared that South Africa's general position on cryptocurrencies is progressive. In 2014, the Reserve Bank of South Africa issued a paper stating the country's position on digital currencies. The content of the paper appeared promising to traders in the virtual currency industry. In July 2017, the South African government collaborated with Bankymoon, a blockchain-based solutions provider, to draw a balanced-based regulation for bitcoins. Unlike most of the countries discussed in this section, South Africa remained tight-lipped on digital currency regulation in 2018.

There are no definitive laws regulating cryptocurrency trading in South Africa. In effect, there are no laws protecting investors in the virtual currency markets in the country. Traders in the virtual financial markets can buy and sell digital currencies on various platforms. However, cryptocurrencies are not defined as securities as stipulated in the Financial Markets Act of 2012 (Act No. 19, 2012). This implies regulatory standards that are applicable to trading in securities in South Africa do not apply to cryptocurrencies. Although cryptocurrency trading remained integrally unregulated in South Africa, Goitom (2019) believed there is light at the end of the financial tunnel; proposed legislations could reverse the trend positively to the benefit of all parties including virtual exchange operators, investors and the South African government.

Passage of a Taxation Law Amendment Bill which was laid before the South African Parliament in 2019 was expected to categorise crypto-assets as financial instruments under the 1962 Income Tax Act. The amended law would subject investments and transactions involving cryptocurrencies under the 1962 Act's 'ring-fencing of asset losses clause' (Goitom, 2019, para. 1). The amended Bill would categorise buying, selling, collection, acquisition, issuance or transfer of ownership of any crypto-asset as financial service under the 1991 Value-Added Tax (VAT) Act. This would exempt crypto-assets from application of the Act (Goitom, 2019, para. 1).

4.3.12 South Korea

Bitcoin Magazine and Nelson (as cited in Ashley, 2018) revealed South Korea was one of the economies with strong presence in the digital currency space. It became an attractive destination to cryptocurrency investors following the introduction of strict regulations in China in the latter part of 2017. However, investors' hope of continually friendly investment environment in South Korea suffered a setback in January 2018, as top officials in the South Korean government became divided on future regulatory measures to adapt for the cryptocurrency industry. The officials were divided on the type of information to clarify and declare; the accuracy of information that was circulated;

and whether to allow limited or broader implementation of digital currency legislation in the economy.

On 23rd January, 2018, the South Korean government began enforcing a legislation that did not permit use of anonymous accounts in trading in digital currencies. There were six Korean banks with branches in the State of New York in the United States of America during the period. To further clamp down on the activities of cryptocurrency traders, the South Korean government, on 26th January, 2018 requested for customer information on accounts related to digital currency trading in the six South Korean bank branches from the New York State's Department of Financial Services (DFS). This resulted in massive sell-offs of digital currencies on 30th January, 2018 (Bitcoin Magazine & Nelson as cited in Ashley, 2018).

However, request of the South Korean government was not granted by the New York State's Department of Financial Services. Some industry analysts believed reluctance of the Department of Financial Services dealt a major blow to the South Korean government's efforts at implementing tougher rules on the cryptocurrency industry during the period (Ashley, 2018).

In March 2020, financial regulators in South Korea amended their existing laws to align with standards set by the Financial Actions Task Force. This followed a court ruling in France on 26th February, 2020 in which bitcoin was recognised as a medium of exchange; and belonging to the financial assets class in the country. Prior to these ruling and legislation review, South Korea was on record to have banned cryptocurrency transactions that were anonymous; the ban was in vogue for several years. Under the revised legislation, virtual currency exchanges in South Korea are obliged to open bank accounts with real names to reassure existing and potential investors of safety of their investments (Salami, 2020b). This would reduce the high level of anonymity, increase the financial responsibility of virtual exchanges; and increase protection for investors.

4.3.13 Switzerland

As part of measures to strengthen and facilitate cryptocurrency trading in the country, the Swiss government thought it expedient to establish an initial coin offering working group. The working group was finally established on 18th January, 2018. The purpose of this group was to ensure legal certainty of the cryptocurrency industry is enhanced while the integrity of the Swiss financial sub-sector is maintained. Further, the group sought to ensure the implementation of technology-neutral regulation. The initial coin offering group was expected to do due diligence; and to submit a report to the Swiss Federal Council by the end of 2018 (Nelson as cited in Ashley, 2018).

On 18th January, 2018 Mr. Johann Schneider-Ammann, the Swiss Economics Minister, declared his country's readiness to become the *crypto-nation*. The State Secretary at the Finance Ministry, Jörg Gasser, noted the Swiss government's interest in observing a prosperous initial coin offering market, but not based on compromise of standards; or compromise on integrity of the financial market (Ashley, 2018). The foregoing pronouncements were not surprising; Switzerland is noted for maintaining progressive attitudes on the rights of individuals in banking; and similar rights are being granted to investors in the digital currency markets. The seemingly relaxed digital currency regulation in Switzerland may make the nation attractive to investors from other jurisdictions where there are clamp-downs and strict regulatory measures on cryptocurrencies including bitcoin trading (Nelson as cited in Ashley, 2018). Operations of virtual exchange markets in Switzerland are subject to approval of the financial regulator, Financial Market Supervisory Authority (FINMA), which is responsible for financial markets, banking supervision and insurance firms, among others.

4.3.14 United Arab Emirates

On 28th February, 2020, authorities in the United Arab Emirates thought it expedient to review their existing legislation on financial services to align with standards of the global anti-money laundering body, the Financial Actions Task Force, after a court ruling in France on 26th February, 2020 upheld bitcoin as a legal tender under the French financial laws. However, as of November, 2020 there were no definitive laws regulating cryptocurrency trading in the United Arab Emirates; the virtual financial market in the country was still waiting for final legislation on cryptocurrency and related assets' trading. The foregoing notwithstanding, cryptocurrency trading was still in vogue in the United Arab Emirates; and guided by the detailed framework of the Financial Services Regulatory Authority (FSRA). Framework of the Financial Services Regulatory Authority provides regulatory requirements for operating crypto-asset businesses including know-your-customer rules, allowed crypto assets and holding equivalent capital resources, among others (Administrator, 2020).

To expedite the formal legislation process, the Securities and Commodities Authority (SCA) in the United Arab Emirates was committed to completing impending legislative infrastructure for crypto-assets in relation to financial markets, and financial instruments. SCA was committed to ensuring funds of investors in the cryptocurrency industry were protected. Finally, SCA was committed to flushing-out money laundering and terrorism financing in the United Arab Emirates (Administrator, 2020).

There are three major regulatory bodies on cryptocurrency trading in the United Arab Emirates. These include the Dubai Financial Services Authority (DFSA), responsible for free zones regulations; Central Bank who serves as the federal regulators for UAE; and the Securities and Commodities Authority. Each of these bodies has a different regulatory position on cryptocurrency. Detailed explanation on the level of progress made by the United Arab Emirates in the enactment of laws related to cryptocurrency trading can be found in the publication by the Administrator on 5th November, 2020.

4.3.15 United States of America

Concerns about the rapid growth of bitcoin in the financial space were raised by the United States Congress in 2013. As a result, the Senate thought it necessary to assess effectiveness of the decentralised digital currency systems that have attracted global attention. To this end, in November 2013, the United States Senate Committee on Homeland Security and Government Affairs began hearing from various stakeholders as a step towards crafting laws to regulate the activities of bitcoin and other cryptocurrencies exchanges in the country (Pagliery, 2013; Nelson, 2018).

Contrary to its initial stance, in early 2018, the United States Senate deemed it appropriate to dialogue with stakeholders in the bitcoin and altcoins' industry before drafting comprehensive laws to regulate digital currencies. This development notwithstanding, some lawmakers raised concerns about the "geometric" increase in value of the bitcoin trade. The United States Justice Department believed it required the assistance of other government agencies and civilians to apprehend criminals who operate through the bitcoin and altcoins systems in the virtual financial markets. Some authorities in the United States bemoaned the possibility of digital currencies becoming equivalent to a bank account in Switzerland; and expressed interest in partnering other G20 member-nations to avert its occurrence (Ashley, 2018).

Further, lawmakers in the United States expressed reservations about new developments in the bitcoin and altcoins markets. That is, the introduction of initial coin offerings which involved sourcing funds through the use of digital tokens. The lawmakers believed the existing Federal laws

must be beefed-up to effectively deal with fraud and theft that may be associated with use of digital currencies in the country. In the United States, it was hoped through concerted efforts of the Justice Department, Commodity Futures Trading Commission, Securities and Exchange Commission, and Senate Banking Committee, among others, a comprehensive legislation could be passed to regulate, effectively, activities of the virtual currency markets. However, users of bitcoin and other cryptocurrencies in the United States have consistently urged government to stay clear of the digital currency systems, so the virtual financial markets in the country could flourish (Bitcoin Magazine, 2018; Nelson, 2018; Reutzel et al., 2018; Romm, 2018).

As of 2018, some academic researchers in the United States had affirmed crypto-assets including bitcoin are endowed with innovative potentials; and that, any attempt by the authorities to impose burdensome regulations on their usage in the country could push the trade outside the country's borders. Some financial pundits believed bitcoin and altcoins are on a powerful upward trajectory; and any attempt to derail their forward movement in the global virtual financial space may be an exercise in futility; what is required are security measures to effectively protect individual, corporate and national investments from predatory and sophisticated hackers; and regulatory measures to devoid the digital currencies of harmful socio-economic effects at the hands of virtual exchange operators (Ashley, 2018).

In September 2013, the United States government shut down an online market called *Silk Road* for trading in drugs and other illicit products. During the shutdown, the Federal Bureau of Investigations (FBI) seized 170,000 bitcoins valued at US$101 million. This virtual financial firm was believed to be encouraging anonymity through the use of bitcoins in its transactions. However, several other virtual firms emerged after the closure of Silk Road by the United States government; and transactions in bitcoins were carried out using coded wallets and special keys. No real names were required in bitcoin transactions. This guaranteed substantial privacy to the detriment of security agencies' ability to fight crime within and across borders (Ashley, 2018).

In 2018, a major DeFi project in New Jersey in the United States failed and whopping sum of US$133 million was returned to investors because DeFi could not work within rules of the Securities and Exchange Commission (Cheah, 2020). In 2020, owners of BitMex, one of the leading derivatives exchanges in the cryptocurrency industry, were indicted by regulatory authorities in the United States for operating without being duly registered in the country; and allegedly flouting anti-money laundering rules. Reports indicated the indictment led to panic withdrawal by its investors; about 30% of investors' funds were withdrawn after authorities in the United States issued charges against BitMex. This liquidity crisis notwithstanding, BitMex noted it was still open for business to serve existing and potential investors (Brown, 2020).

In spite of the hard stance on private operators, plans were underway for the Federal Reserve and other members of the G5 Banks including the Bank of England, Swiss National Bank, European Central Bank and Bank of Japan to develop their unique digital currencies called "central bank digital currencies or CBDCs" (Potts & Rennie, 2020). As stated in the preceding section, China had already taken bold steps to circulate her own digital currency known as digital renminbi on a pilot basis. In a related development, the Financial Crimes Enforcement Network (FinCEN) has proposed regulations to control cryptocurrencies and their related activities in the United States. The proposed law calls for the collection of names and addresses of persons engaging in cryptocurrency transactions in excess of US$3,000. The overarching idea is to facilitate tracking of illicit transactions by law enforcement officials and agencies (Hamilton, 2021).

Although outright acceptance of trading in bitcoin and altcoins is perceived by some analysts as a recipe for disaster for the traditional financial institutions, including mainstream banks, Cheah

(2020) argued exigencies of the time call for change in the financial markets' status quo; key actors in the global financial space such as regulators and multinationals who influence nation-states (Brown & Whittle, 2020) must be ready to accept change to address teething problem in the industry. That is, they must be ready to replace age-old or antiquated financial system perceived as anti-progress and anti-growth with one that is characteristically contemporaneous. Demonstrably, in July 2020, financial regulator in the United States, the Securities and Exchange Commission took a bold step in this regard; for the first time, SEC embraced DeFi by approving Arca, an ethereum-based fund (Cheah, 2020). It is hoped careful observation and audit of operations of other virtual exchanges in subsequent periods would lead to their approval in the United States; and in other jurisdictions.

The initiatives to introduce unique bitcoins were found not to be limited to national governments; there were some developments at the institutional level. As at January 2020, JP Morgan was reported to have already launched a digital coin (JPM coin) for its major institutional clients while many other major banks were ready to follow suit. As part of measures to speed up bank transactions and payments, seventy-five of the world's largest banks were implementing blockchain technology on trial-basis during the research period. These banks are members of the *Interbank Information Network*, which is led by JP Morgan, ANZ and Royal Bank of Canada (Cheah, 2020). Technology giants such as Apple, Amazon and Google were speculated to have taken steps to launch their respective rival digital tokens, in spite of the setbacks to Facebook's attempts in recent years (Brown & Whittle, 2020). In December 2020, financial regulators in the United States proposed the *US Stable Bill* for adaption and implementation to regulate bitcoin and altcoins trading in the country (Urquhart, 2020).

4.3.16 Venezuela

Between 2016 and early 2017, there were no clear-cut laws regulating cryptocurrency trading activities; the status of bitcoin and altcoins in the financial markets was not clearly defined in Venezuela. The void in financial regulations allowed law enforcement officials to subject the virtual financial market in the country to abuse and corruption (Aguilar, 2020). To restore sanity and repose confidence of investors in the country's financial system, in 2017, the Venezuelan government compiled a detailed registry of digital currency miners as a significant step towards controlling digital currency activities and arresting free fall of the Venezuelan bolivar. As at December 2017, the Venezuelan bolivar was virtually unusable, following international restrictions and sanctions imposed on the regime of President Nicolás Maduro by advanced economies such as the United States of America (Ashley, 2018).

In order to liberate the Venezuelan economy from the shackles of international restrictions, the President Nicolás Maduro-led government announced the introduction of a digital currency called ***petro***, which was backed by the country's oil. The state-approved cryptocurrency could allow Venezuela to become a strong force to reckon with in the world of digital currencies; it could allow Venezuela to emerge among global economies with progressive regulations on virtual currencies (Nelson as cited in Ashley, 2018).

On 21st September, 2020, Venezuela officially legalised and gazetted (Official Gazette No. 41,969) mining of bitcoin. This initiative further placed the country on the global radar of economies, notably after Japan, China, Canada, Singapore and others, to have officially reccognised cryptocurrencies including bitcoin as viable income-generating source. Authorities in Venezuela believed legalising bitcoin mining could boost economic growth through increased incomes.

Although Venezuela has succeeded in drafting a legal framework to regulate bitcoin and altcoins trading, Aguilar (2020) noted the framework is embedded with gaps and inconsistencies. These gaps and attendant inconsistencies have paved way for corruption to dominate the existing legal framework. These setbacks notwithstanding, Venezuelans' appetite for investments in cryptocurrencies including bitcoin is on the increase; the virtual exchange market in the country is gaining grounds as more Venezuelans aspire to obtain American dollars to trade for bolivars.

4.3.17 Zimbabwe

In May 2018, the financial services regulatory authority in Zimbabwe known as the Reserve Bank of Zimbabwe (RBZ) banned transactions, including payments processing between cryptocurrency firms and banks. However, reports carried by the Zimbabwean local newspaper, The Chronicle (as cited in Khatri, 2020), revealed admission of the Zimbabwean central bank to the fact that the crypto trend is a reality. Following this realisation, the Reserve Bank of Zimbabwe took steps to draft a policy framework to guide operations and activities of virtual currency operators in the country. In effect, the central bank considered factors such as economic need, to lift the ban on cryptocurrency trading in the country.

The framework, known as the *Fintech framework*, was expected to be well-structured to assess virtual currency firms and their mode of operation in the country. The assessment outcomes would inform the regulatory body's decision on cryptocurrency trading in Zimbabwe, a country embroiled in economic challenges in the last few years. Successful investments in digital currency trading could assuage the financial "pain" endured by investors in the Zimbabwean economy in the last few years. However, this investment feat is predicated on a number of factors, including enactment of regulations that would ensure due diligence; and protect funds of investors from the exploits of virtual exchange operators and predatory cyber-hackers.

4.4 Concluding Remarks

The Financial Actions Task Force comprised more than thirty-seven member-countries as of 27th March, 2020. These included the United States and United Kingdom while many more countries were expected to sign up; and to align their respective financial services legislations with standards set by the Financial Actions Task Force. Member-countries had until June 2020 to review their existing financial services legislations to align with FATF standards. This explains on-going policy reviews by some economies including Germany, France, United Kingdom, United Arab Emirates, South Korea and Zimbabwe, among others, in recent periods. New standards set for virtual currency exchanges and their related businesses are explicit; and these rules are expected to facilitate transactions between virtual currency operators and banks. This opportunity extends to individual and corporate investors in the cryptocurrency markets (Salami, 2020b).

As stated earlier, hackers who hack into blockchain and related systems to steal virtual currencies operate with technological sophistry. These hackers have the technological ability to fake their identity and location; and to apportion blame on innocent third parties. Besides, it is quite herculean to trace stolen digital currencies to logical conclusions. Even where the perpetrators are traced to a particular jurisdiction, without identifying the "real" actors, it is difficult to file for compensation against the jurisdiction or country at the international level. Finlay and Payne (2019) identified attribution as a major challenge to "aggrieved" countries in international law. Current provisions in international law stipulate for a country to be accused of any wrong-doing, the "offended' country must be able to establish attribution. That is, it should be able to demonstrably attribute the act to the "accused" country. An act could be attributed to a country when either of its organs, including officials, government or departments is involved.

Although governments of many economies do not approve of cryptocurrency trading activities, it may be difficult to attribute cyber-attacks on virtual exchanges to them. Further, actions of non-state actors (persons not directly employed by the country) cannot be attributed directly to the country unless it could be established that the activities of these private individuals or groups have been sanctioned by the country through adoption of their conduct, or control of their activities. Recent judgements by the International Court of Justice on cyber-attacks revealed the principle of *effective control* must be established when seeking attribution. However, the establishment of attribution does not bring the legal complexities in international law to an end; other mechanisms must be implemented including allowing effective response from the accused country.

Finlay and Payne (2019) noted proof of geographic location of hackers; and proof of financial equipment and aid used by system-hackers may not suffice to pass the litmus test of *effective control* in international law. The legal provisions in international law make it difficult for any country to be held openly liable for cyber-attacks on virtual exchanges. Perhaps, role of the Financial Actions Task Force in global financial regulations may increase the responsibilities of countries to investors in the virtual exchange space. Fortunately, countries such as Japan, Singapore, South Korea, France, Germany, United Arab Emirates, and others, are responding favourably. This assurance of protection by the state could serve as incentive and morale booster to existing and potential investors in the virtual currency markets across the globe.

4.5 Descriptive Statistics

This section presents a summary of bitcoins circulated on quarterly basis during the research period. Statistical summary of total bitcoins circulated quarterly from 2012 through 2020 and included in the analysis is presented in Figure 1. Analysis in the figure drew on data in Table 1, column 2; and Figure 2. Data in Figure 1 indicate the respective sample variance (5881760984848.5) and skewness (-0.549570667) for the distribution. The value for sample variance (5881760984848.5) tells us the expectation of squared deviation of the research random variable from its mean. Skewness explains the distortion or asymmetry of the random variable around the mean in the distribution. The statistical data depict respective Kurtosis and standard error values of -0.888603749392612 and 422179.086832881. The extent to which the coefficients are significantly different from zero is explained by the standard error value. The minimum value in Figure 1 is 10,610,000. This represents total bitcoins circulated during the fourth quarter of 2012.

Figure 1: Statistics on Quarterly Circulated Bitcoins

Mean	15477878.7878788
Standard Error	422179.086832881
Median	16080000
Mode	#N/A
Standard Deviation	2425234.2123697
Sample Variance	5881760984848.5
Kurtosis	-0.888603749392612
Skewness	-0.549570667
Range	7990000
Minimum	10610000
Maximum	18600000
Sum	510770000
Count	33

Largest(1)	18600000
Smallest(1)	10610000
Confidence Level (95.0%)	859950.655059417

The maximum value (18,600,000) is representative of total bitcoins circulated in the fourth quarter of 2020. The range explains the difference between the maximum and minimum values for the distribution. Value for the *range* (7990000) in Figure 1 explains the substantial difference (7,990,000) between the respective total bitcoins circulated in the fourth quarter of 2020 (18,600,000); and the total number circulated during the fourth quarter of 2012 (10,610,000). The value for sum (510,770,000) in Figure 1 depicts the total number of bitcoins circulated during the period and included in the analysis. This value is significant relative to the estimated total number of mined bitcoins (21,000,000) available for circulation on various virtual exchanges across the globe.

As of 11th December, 2020, Ycharts (2020b) estimated daily bitcoin transactions at 311,657. The respective average costs per bitcoin transaction and ethereum transaction were US$51.910 and US$2.394. This suggests the average cost per bitcoin transaction was about 21.68 times (US$51.910 ÷ US$2.394 = 21.683375 = 21.68) the average cost per ethereum transaction during the period. Similarly, total number of circulated bitcoins as of 31st December, 2020 was estimated at 18.6 million, meaning there were 2.4 million (21 million – 18.6 million = 2.4 million) bitcoins outstanding. Total number of bitcoins mined and circulated (18.6 million) was equivalent to 88.6% of all mined bitcoins (21 million) while the number in the coin vault or outstanding (2.4 million) was equivalent to 11.4% of total mined bitcoins (Faridi, 2021).

Akin to Figure 1, data on total bitcoins circulated on quarterly basis from 2012 through 2020 are presented in Table 1 and Figure 2. Statistics in the table and figure depict significant increase in the total number of bitcoins circulated between the fourth quarter of 2012 and the fourth quarter of 2014. The global virtual currency markets recorded about 28.84% ((13,670,000 - 10,610,000) ÷ 10,610,000) x 100% = (3,060,000 ÷ 10,610,000) x 100% = 0.28840716 x 100% = 28.8407 = 28.84%) increase in total bitcoins circulated between 2012 (10,610,000) and 2014 (13,670,000). This was higher than the estimated 17.63% increase recorded between 2014 and 2016. Similarly, actual total bitcoins circulated between 2014 and 2016 increased by 2,410,000. This was low compared to the 3,060,000 increase recorded between 2012 and 2014. The data suggest demand for and corresponding supply of bitcoin between 2012 and 2014 were higher than between 2014 and 2016. This notwithstanding, total supply of bitcoins in the global virtual currency markets did not decrease; supply increased steadily from 2014 through 2016.

Between 2016 and 2018, the global virtual currency markets witnessed 1,370,000 increase (17,450,000 - 16,080,000 = 1,370,000) in total bitcoins circulated. This was equivalent to 8.52% increase during the period. Steady increase in total bitcoins circulated implies uncertainties in the mainstream global financial markets had little adverse impact on the circulation and performance of bitcoin on the various virtual exchanges; and minimal negative effect on the performance of bitcoin in terms of pricing in the global business environment. The highest percentage increase (3.70%) in circulated bitcoins was recorded in the third quarter of 2013. Conversely, the lowest percentage increase (0.43%) in circulated bitcoins was recorded in the third quarter of 2020.

Table 1: Quarterly Circulated Bitcoins

Quarter	Bitcoins Circulated	% Increase in Bitcoins Circulated
Q4 2020	18,600,000	0.54
Q3 2020	18,500,000	0.43

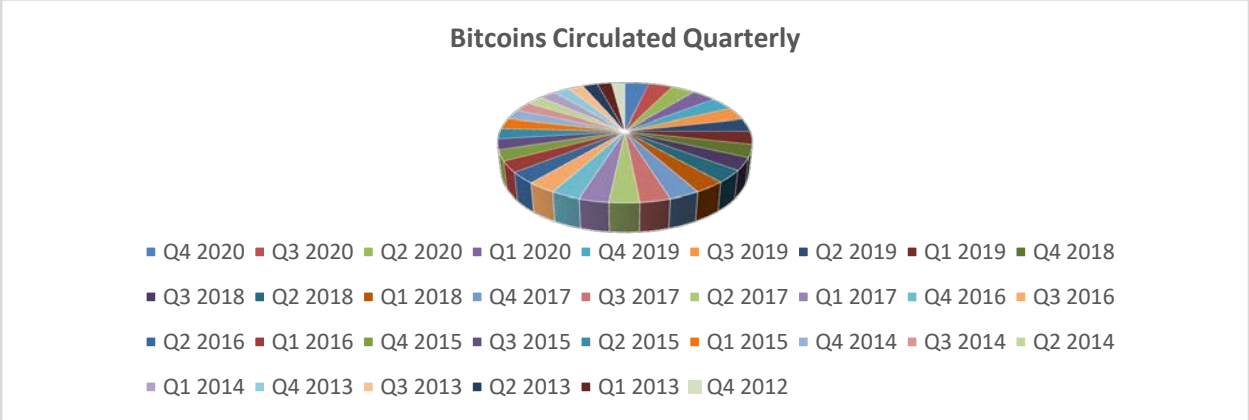
Q2 2020	18,420,000	0.66
Q1 2020	18,300,000	0.94
Q4 2019	18,130,000	0.89
Q3 2019	17,970,000	1.01
Q2 2019	17,790,000	0.97
Q1 2019	17,620,000	0.97
Q4 2018	17,450,000	0.87
Q3 2018	17,300,000	1.05
Q2 2018	17,120,000	1.00
Q1 2018	16,950,000	1.01
Q4 2017	16,780,000	1.08
Q3 2017	16,600,000	1.10
Q2 2017	16,420,000	1.05
Q1 2017	16,250,000	1.06
Q4 2016	16,080,000	1.13
Q3 2016	15,900,000	1.15
Q2 2016	15,720,000	2.21
Q1 2016	15,380,000	2.33
Q4 2015	15,030,000	2.45
Q3 2015	14,670,000	2.37
Q2 2015	14,330,000	2.36
Q1 2015	14,000,000	2.41
Q4 2014	13,670,000	2.55
Q3 2014	13,330,000	2.78
Q2 2014	12,970,000	3.02
Q1 2014	12,590,000	3.20
Q4 2013	12,200,000	3.65
Q3 2013	11,770,000	3.70
Q2 2013	11,350,000	3.46
Q1 2013	10,970,000	3.39
Q4 2012	10,610,000	-

Reiff (2020) and Chan (n.d.) noted the availability of over two thousand cryptocurrencies in circulation. However, it is worth reiterating a significant proportion of total cryptocurrencies circulated globally is contributed by bitcoin. Theoretically and practically, bitcoin continues to assert its role as the original cryptocurrency through increased number of circulated cryptocurrencies; and higher market capitalisation value in the virtual financial markets across the globe. Data in column 3, Table 1, indicate percentage increase in bitcoins circulated on quarterly basis throughout the period under review. A common trend observed in the data in column 3, Table 1, is parsimonious increase in circulated bitcoins; the estimated percentage increase in circulated bitcoins for each quarter is less than 4%. Average percentage increase in circulated bitcoins from the fourth quarter of 2012 through the fourth quarter of 2020 is 1.72%. Marginal percentage increases in quarterly circulated bitcoins were recorded from the fourth quarter of 2018 through the fourth quarter of 2020.

Glassnode (as cited in Faridi, 2021) provided on-chain market analysis of bitcoin and other cryptocurrencies in the global virtual currency markets. Glassnode's analysis (as cited in Faridi, 2021) revealed about 14.5 million of the 18.6 million bitcoins circulated were being held by illiquid companies. This number represented approximately 77.97% ((14.5 million ÷ 18.6 million) x 100% = 0.779699 x 100 = 77.9699 = 77.97%) of total bitcoins circulated. The report suggested investors in the virtual currency markets trade in bitcoins more as a store of value than for day-to-day transactions and payments purposes, implying investors' preference for bitcoin as financial investment tool was on the increase during the research period. Total bitcoins circulated increased from 17.45 million in 2018 to 18.6 million in 2020, suggesting a differential increase of 1.15 million. The latter represents about 6.59% increase over the period.

Generally, a marginal increase in supply relative to high demand is likely to impel upward movement of the unit price of bitcoin in the global digital currency markets. It was therefore imperative to measure and assess the price movement of bitcoin over the research period. A summary of statistical distribution of bitcoin prices from the fourth quarter of 2012 through the fourth quarter of 2020 is presented in Figure 3. The price distribution data in Table 2, column 2 and Figure 4 were used for the analysis in this section. Figure 3 presents data on measures of central tendency such as the mean, median and mode; and measures of dispersion such as the range, minimum, maximum, and standard deviation (Ashley et al.; Frankfort-Nachmias and Nachmias, 2008) for the quarterly bitcoin price values used in the research.

Figure 2: Quarterly Circulated Bitcoins



Data in Figure 3 depict the respective highest (29,053.17) and lowest (4.91) quarterly bitcoin price values recorded during the research period. The highest value (US$29,053.17) describes performance of bitcoin in the global financial markets in an economic period (2020) characterised by portentous pandemic outbreak. The historically-high per unit price of bitcoin recorded at the end of 2020 (US$29,053.17) affirmed the role of bitcoin and altcoins as viable investment alternatives during periods of uncertainties in the global financial markets. The lowest per unit price in the figure (US$4.91) was recorded in the fourth quarter of 2012, the early formative years of bitcoin and its gradual acceptance in the global virtual financial markets. Data in the figure indicate the *range* of quarterly bitcoin prices during the period is 29048.26 (US$29,048.26). This represents the difference between the highest (US$29,053.17) and lowest (US$4.91) quarterly bitcoin price values during the research period.

Figure 3: Statistics on Quarterly Bitcoin Prices

Mean	3834.05333333333
Standard Error	966.991815349138

Median	699.845
Mode	#N/A
Standard Deviation	5801.95089209483
Sample Variance	33662634.15428
Kurtosis	9.40809946307668
Skewness	2.65895907310304
Range	29048.26
Minimum	4.91
Maximum	29053.17
Sum	138025.92
Count	36
Largest(1)	29053.17
Smallest(1)	4.91
Confidence Level (95.0%)	1963.09773851402

An obvious effect of the limited supply of bitcoin relative to its demand for daily trading purposes is an increase in the per unit price. Therefore, it was not a surprise to witness significant jump in price of bitcoin between the first quarter (US$6,427.70) and last quarter (US$29,053.16) of 2020 by about 352% ((US$29,053.16 - US$6,427.70) ÷ US$6,427.70) x 100% = (US$22,625.46 ÷ US$6,427.70) x 100% = 0.35199932 x 100% = 351.999 = 352%). Total circulated bitcoins that were highly liquid in supply were 3 million; and the remaining 1.1 million circulated bitcoins (18.6 million – (14.5 million + 3 million) = 18.6 million – 17.5 million = 1.1 million) were liquid in supply. Cumulatively, there were about 4.1 million circulated bitcoins readily available for buying and selling on the global virtual exchanges; the remaining 14.5 million were being hoarded; and these were equivalent to 77.96% during the period. The significant number of circulated bitcoins hoarded (14.5 million) was indicative of a bullish market trend in the medium-term.

The year 2017 is quite historic in the annals of bitcoin history. It is the financial year in which bitcoin's price per token increased from US$5,000.00 to US$20,000.00 for the first time. However, the price could not be sustained over a long period; price per token plummeted by over 80% in less than three months after the initial exponential increase by 300% ((US$20,000 – US$5,000) ÷ US$5,000) x 100% = ((US$15,000 ÷ US$5,000) x 100% = 3 x 100% = 300%). Due to the volatilities and resultant fluctuations, the per-token value of bitcoin at the end of the 2017 financial year was US$13,800; the second-highest in the history of bitcoin trading. Nonetheless, volatilities in the price movements of bitcoin have lessened in recent periods. For instance, in the last quarter of 2020, bitcoin's price surged from US$10,000.00 in October 2020 to US$19,000.00 towards the end of November 2020; and increased further to US$29,053.17 at the end of December 2020.

Data in Table 2 and Figure 4 reveal about 303.05% increase in the unit price of bitcoin between the fourth quarter of 2019 (US$7,208.30) and the fourth quarter of 2020 (US$29,053.17); and about 88.18% increase between the fourth quarter of 2018 (US$3,830.50) and the fourth quarter of 2019 (US$7,208.30). Data in the table and figure indicate the per unit price of bitcoin in the early years was low. However, this period was characterised by astronomical increase in price per token of bitcoin as depicted in the significant jump in price of bitcoin (about 5,286.46%) from the fourth quarter of 2012 (US$13.51) to the fourth quarter of 2013 (US$727.71). The increase in per-token price of bitcoin from the first quarter of 2012 (US$4.91) to the fourth quarter of 2013 (US$727.71) was equivalent to 14,720.98%.

Generally, performance of bitcoin in the global cryptocurrency markets has been phenomenal over the years. This is evidenced in 591,614.26% increase in price per token from the first quarter of 2012 (US$4.91) to the fourth quarter of 2020 (US$29,053.17). Details of respective percentage increases in quarterly price of bitcoin over the research period (2012 through 2020) are presented in column 3, Table 2. Data in the table suggest the highest percentage increase in quarterly price of bitcoin (588.60%) was recorded between the fourth quarter of 2012 (US$13.51) and the first quarter of 2013 (US$93.03). Percentage increase in price (491.15%) between the third (US$123.10) and fourth (US$727.71) quarters of 2013 remains the second-highest in the history of quarterly bitcoin prices. The respective third- (216.01%) and fourth-highest (169.16%) percentage increases in bitcoin prices were recorded between third (US$4,367.00) and fourth (US$13,800.00) quarters of 2017; and between third (US$10,794.00) and fourth (US$29,053.17) quarters of 2020. Percentage increase in price of bitcoin (157.82%) between the first (US$4,167.60) and second (US$10,745.00) quarters of 2019 was equally impressive; it is the fifth-highest in the history of the virtual currency (bitcoin). Market volatilities and the concomitant effect on price movements reflect in the negative percentage increases in quarterly prices in periods such as the third (-22.47%) and fourth (-13.48%) quarters of 2019; and the first quarter (-10.83%) of 2020, among others.

Table 2: Quarterly Bitcoin Prices

Quarter	Price in $	% Increase in Price
Q4 2020	29,053.17	169.16
Q3 2020	10,794	17.96
Q2 2020	9,150.60	42.36
Q1 2020	6,427.70	-10.83
Q4 2019	7,208.30	-13.48
Q3 2019	8,331.10	-22.47
Q2 2019	10,745	157.82
Q1 2019	4,167.60	8.80
Q4 2018	3,830.50	-42.12
Q3 2018	6,618.10	3.55
Q2 2018	6,391.50	-7.71
Q1 2018	6,925.30	-49.82
Q4 2017	13,800	216.01
Q3 2017	4,367	80.40
Q2 2017	2,420.70	123.79
Q1 2017	1,081.70	11.67
Q4 2016	968.62	58.98
Q3 2016	609.28	-9.33
Q2 2016	671.98	61.62
Q1 2016	415.78	-3.29
Q4 2015	429.94	81.90
Q3 2015	236.36	-9.98
Q2 2015	262.55	7.55
Q1 2015	244.13	-22.99
Q4 2014	317.00	-18.12
Q3 2014	387.14	-39.51
Q2 2014	640.01	41.60

Q1 2014	452.00	-37.89
Q4 2013	727.71	491.15
Q3 2013	123.10	26.24
Q2 2013	97.51	4.82
Q1 2013	93.03	588.60
Q4 2012	13.51	8.95
Q3 2012	12.40	85.35
Q2 2012	6.69	36.25
Q1 2012	4.91	-

Observed volatilities in the virtual currency markets are affirmed by fluctuations in the per-token price of bitcoin and other cryptocurrencies. Between mid-February and 13th March, 2020, the value per token of bitcoin plunged from US$10,000.00 to less than US$4,000.00; and later appreciated to over US$6,000.00 towards the end of March 2020 (Salami, 2020b). This development drew missed reactions from analysts; others were hopeful of bitcoin price bouncing back while others were pessimistic, and wondered whether per-token value of bitcoin would ever see the positive light-of-day in the global virtual financial markets. Trend analysis in Figure 4 reveals price volatilities were apparent from the first quarter of 2018 through the first quarter of 2019.

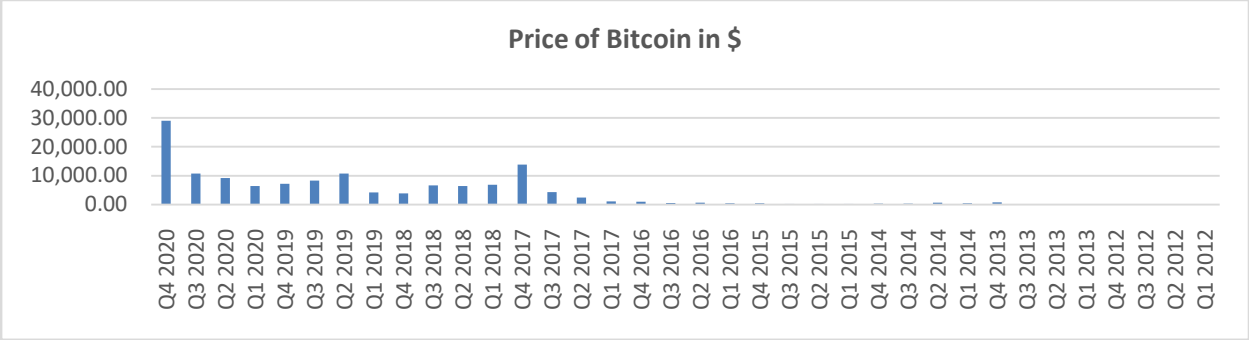
However, further trend analysis in Figure 4 depicts steady increase in per-token price of bitcoin from the fourth quarter of 2016 through the fourth quarter of 2017; and from the first quarter through the fourth quarter of 2020. Available data in Table 2 depict 42.36% increase in bitcoin price between the first and second quarters of 2020; and 17.96% increase between the second and third quarters of 2020. It is worth-noting the marginal percentage increase in third quarter price of bitcoin (17.96%) did not affect its fortunes; market capitalisation value in the third quarter (US$199.689 billion) is the third all-time highest after the respective values recorded in the respective fourth quarters of 2020 (US$540,389 billion) and 2017 (US$231.564 billion) as shown in Table 3 and Figure 4. In late October 2020, PayPal launched its service for purchases, sales and payments for bitcoin. This contributed to dramatic rise in price per unit of bitcoin in the last quarter of 2020; and expected to contribute to price increases beyond 2020. The virtual currency (bitcoin) has the potential of becoming a conventional payment method (Entrepreneur Staff, 2021).

On 30th December, 2020 bitcoin was traded at US$28,900, representing about 63.74% increase over the token price on 12th December, 2020 (US$17,650). The per-token value on 30th December, 2020 (US$28,900) was the new all-time high. Available data from CoinMarketCap and Glassnode (as cited in Del Rio, 2020a) revealed an increase in the unit price of bitcoin to US$28,925 during the period. The closing price per unit of bitcoin registered by Coindesk (as cited in Del Rio, 2020a) on 30th December, 2020 was US$28,969. Glassnode's report (as cited in Del Rio, 2020a) depicted a promising future for bitcoin, given the few tokens or units available in the virtual exchange markets. The report indicated majority of traders acquired bitcoin as a store of value; only 4.1 million of the circulated 18.6 million bitcoins were traded in the virtual exchange markets. In percentage terms, 78% of circulated bitcoins were stored as value while the remaining 22% were traded constantly in the virtual markets for profits or increased returns. The Glassnode report (as cited in Del Rio, 2020) showed the reluctance of some firms to sell their bitcoins, implying the recent bullish market conditions were triggered by high amount of financial illiquidity. The report concluded that shortage in bitcoin supply is a recipe for upward adjustment of its price per token in the global digital currency markets.

There were wild speculations and reports that per-token value of bitcoin could increase to US$100,000 or US$318,000 by the end of 2021. In October 2020, analysts at the global asset management department of JP Morgan Chase predicted the per-token value of bitcoin would double or triple. The prediction was a paradigm shift from earlier pronouncement by Mr. Jamie Dimon, CEO of JP Morgan Chase, which sought to discredit bitcoin; he described bitcoin as "fraud" and "worse than tulip bulbs;" and would show any employee trading in bitcoin the exit door (Potts & Rennie, 2020). Currently, JP Morgan Chase is the largest bank in the United States. Realisation of these remarkable feat was enhanced by the acquisition of Washington Mutual (WAMU) over a decade ago.

Descriptive statistical test was conducted to help provide meaningful summary of market capitalisation values for bitcoin used in the research. Available data in column 4, Table 3 and Figure 6 were useful to the analysis in this section. Results from the statistical test are presented in Figure 5. The statistical output in Figure 5 depicts respective *median* and *mean* of 15575409600 and 73823612396.9697; and standard deviation of 109060212550.166. These tell us the extent to which the observations are dispersed around the central tendency.

Figure 4: Quarterly Bitcoin Prices



The *mode* explains the variable with the highest frequency or number of occurrences in the data. Figure 5 shows no absolute value (#N/A) for the mode. This implies no quarterly market capitalisation value for bitcoin was repeated. That is, there were no two or more quarters with the same market capitalisation values during the period.

Figure 5: Statistics on Quarterly Bitcoin Market Cap. Values

Mean	73823612396.9697
Standard Error	18984946158.7632
Median	15575409600
Mode	#N/A
Standard Deviation	109060212550.166
Sample Variance	1.18941299614875E+22
Kurtosis	9.74663288281368
Skewness	2.69738124849789
Range	540245620900
Minimum	143341100
Maximum	540388962000
Sum	2436179209100
Count	33
Largest(1)	540388962000
Smallest(1)	143341100

Confidence Level (95.0%)	38671069682.7074

Computed quarterly market capitalisation values for bitcoin is presented in Table 3 and Figure 6. Data in Figure 6; and in columns 1 through 3 in Table 3 were obtained from multiple sources, including Statista.com, Crowd Fund Insider, Yahoo Finance, Ycharts.com; the World Bank, IMF and OECD. The fourth quarter price for bitcoin (US$29,053.17) for 2020 as depicted in the table and figure was derived from the average of different closing prices accessed from Yahoo Finance (US$29,001.72), Ycharts.com (US$29,388.94) and Statista.com (US$28,768.84). Data on fourth quarter circulated bitcoins for December 2020 (18.6 million) were accessed from CrowdFundInsider.com; all the remaining quarterly prices and quarterly circulated bitcoins were obtained from Statista.com. The World Bank, IMF, OECD and Statista.com proved useful to gathering of data on annual global GDP values in column 3, Table 5.

Data on market capitalisation values for bitcoin are presented in column 4, Table 3. Market capitalisation value (MCV) for each quarter equals the number of circulated bitcoins (CB) multiplied by price per token (P) during the period. That is, MCV = CB x P. In effect, market capitalisation value equals total revenue derived from sales of circulated bitcoins during the period. Brown and Whittle (2020) reported over 40% increase in value of bitcoin in early December 2020. However, value-increases recorded by altcoins such as bitcoin SV, ethereum and bitcoin cash were in triple digits during the period.

Table 3: Quarterly Bitcoin Market Capitalisation Values

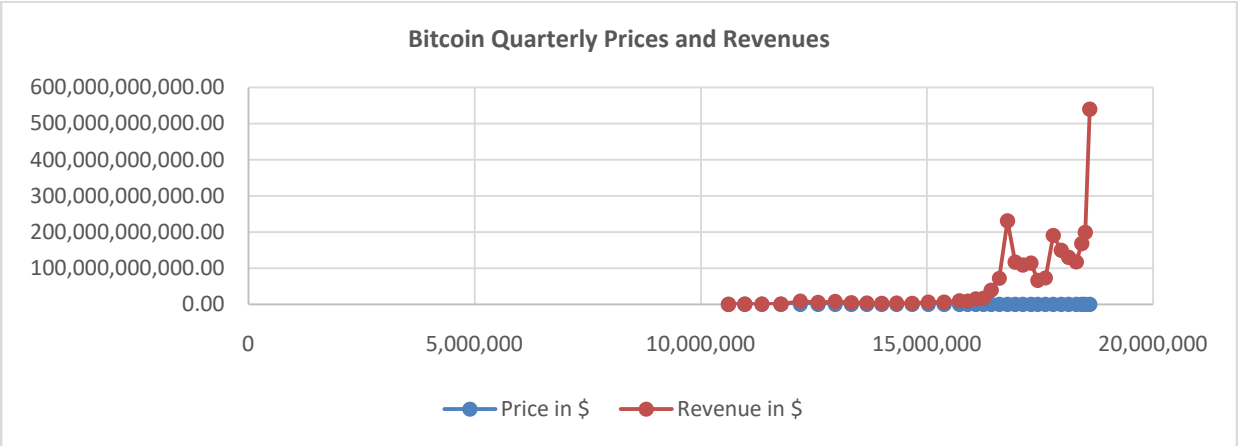
Quarter	Circulated Bitcoins x	Price in $ =	Market Cap Value in $	% Increase in Mkt. Cap
Q4 2020	18,600,000	29,053.17	540,388,962,000	170.62
Q3 2020	18,500,000	10,794	199,689,000,000	18.47
Q2 2020	18,420,000	9,150.60	168,554,052,000	43.30
Q1 2020	18,300,000	6,427.70	117,626,910,000	-9.99
Q4 2019	18,130,000	7,208.30	130,686,479,000	-12.71
Q3 2019	17,970,000	8,331.10	149,709,867,000	-21.68
Q2 2019	17,790,000	10,745	191,153,550,000	160.31
Q1 2019	17,620,000	4,167.60	73,433,112,000	9.86
Q4 2018	17,450,000	3,830.50	66,842,225,000	-41.62
Q3 2018	17,300,000	6,618.10	114,493,130,000	4.63
Q2 2018	17,120,000	6,391.50	109,422,480,000	-6.78
Q1 2018	16,950,000	6,925.30	117,383,835,000	-49.31
Q4 2017	16,780,000	13,800	231,564,000,000	219.43
Q3 2017	16,600,000	4,367	72,492,200,000	82.38
Q2 2017	16,420,000	2,420.70	39,747,894,000	126.13
Q1 2017	16,250,000	1,081.70	17,577,625,000	12.86
Q4 2016	16,080,000	968.62	15,575,409,600	60.78
Q3 2016	15,900,000	609.28	9,687,552,000	-8.29
Q2 2016	15,720,000	671.98	10,563,525,600	65.19
Q1 2016	15,380,000	415.78	6,394,696,400	-1.04
Q4 2015	15,030,000	429.94	6,461,998,200	86.36
Q3 2015	14,670,000	236.36	3,467,401,200	-7.84
Q2 2015	14,330,000	262.55	3,762,341,500	10.08

Q1 2015	14,000,000	244.13	3,417,820,000	-21.13
Q4 2014	13,670,000	317.00	4,333,390,000	-16.03
Q3 2014	13,330,000	387.14	5,160,576,200	-37.83
Q2 2014	12,970,000	640.01	8,300,929,700	45.87
Q1 2014	12,590,000	452.00	5,690,680,000	-35.90
Q4 2013	12,200,000	727.71	8,878,062,000	512.75
Q3 2013	11,770,000	123.10	1,448,887,000	30.92
Q2 2013	11,350,000	97.51	1,106,738,500	8.45
Q1 2013	10,970,000	93.03	1,020,539,100	611.97
Q4 2012	10,610,000	13.51	143,341,100	-

Statistics in the table and figure indicate the second-highest quarterly price per token of bitcoin was recorded in the fourth quarter of 2017 (US$13,800.00). However, during the same year, bitcoin recorded its first-ever all-time high per-token value of US$20,000.00, equivalent to £15,000.00 (Salami, 2020a). The per token price of bitcoin in the third quarter of 2020 (US$10,794.00) is the third-highest after the price recorded in the fourth quarter of 2020 (US$29,053.17); and in the fourth quarter of 2017 (US$13,800.00). There is no gain-saying the global stock markets were one of the hardest-hit by the COVID-19 pandemic in 2020; most stock markets struggled to break-even in the 2020 financial year. However, data in Figure 6 and Table 3 depict steady increase in the per-token value of bitcoin from first through the fourth quarters of 2020. The virtual currency (bitcoin) witnessed respective 43.30% and 18.47% increases in price during the second and third quarters of 2020; and exponential increase (170.62%) in the last quarter. Tremendous performance of bitcoin in 2020 in spite of the COVID-19 outbreak explained the general behaviour of investors in the stock markets. That is, the tendency to look for viable alternative investments when stock prices begin to plummet in the global financial markets, owing to uncontrollable internal and external factors. Under the circumstance, cryptocurrencies such as bitcoin rob-shoulders with gold as viable investment alternatives in the global financial markets. Swanepoel (as cited in Urquhart, 2020) projected overall growth in bitcoin's market capitalisation value between 2020 and 2024 at 270%. Data in Table 3 suggest the respective first- (611.97%), second- (512.75%), third- (219.43%) and fourth-highest (170.62%) percentage increases in market capitalisation values for bitcoin were recorded in the first quarter of 2013, fourth quarter of 2013, fourth quarter of 2017 and fourth quarter of 2020. Percentage increases in market capitalisation values for bitcoin in the second quarter of 2019 (160.31%); and second quarter of 2017 (126.13%) were equally impressive and significantly high.

In January 2020, Brown and Whittle (2020) predicted gradual dissipation of bitcoin and other cryptocurrencies from the global financial system; and that, the periods in which these virtual currencies denied central banks and giant corporate bodies of valuable sums of money were virtually over. The authors' argument suggested the market capitalisation values for bitcoin and altcoins at the end of the 2020 financial year would be less than their values at the beginning of the financial year. As at the time of the authors' submission in January 2020, the market capitalisation value for bitcoin was US$133 billion. However, market capitalisation value for bitcoin at the end of December 2020 (US$540 billion) as shown in Figure 6 and Table 3, column 4 rejected Brown and Whittle's (2020) assertion; the end-of-financial year market capitalisation value for bitcoin (US$540 billion) was about 306.02% increase over the value (US$133 billion) at the beginning of the 2020 financial year.

Figure 6: Quarterly Bitcoin Market Capitalisation Values



As at the end of the third quarter of 2020, the market capitalisation value for bitcoin as displayed in the table and figure was US$199.689 billion, representing about 50.14% ((US$199,689,000,000 – US$133,000,000,000) ÷ US$133,000,000,000) x 100% = US$66,689,000,000 ÷ US$133,000,000,000) x 100% = 0.5014211 x 100% = 50.142211 = 50.14%) increase over the value (US$133 billion) at the beginning of the 2020 financial year. Thus, performance of bitcoin towards the end of 2020 depicted steady increase in its market capitalisation value, and not decelerated performance. This evidence further rejected Brown and Whittle's (2020) prediction; and supported Brown (2020), Jorner (2020), Urquhart (2020), and Potts and Rennie (2020) who were upbeat about the future prospects of bitcoin and other cryptocurrencies in the global virtual exchange markets.

Further, recent report released by the Deutsche Bank (as cited in Brown and Whittle, 2020) suggested national fiat currencies could be over-taken by cryptocurrencies in the next ten years; and that state-backed versions would lead the digital currencies' crusade in the global financial markets. Deutsche Bank has over 78,000 working staff in more than 70 countries; it remains a leading investment bank with strong and profitable private clients franchise across the globe. The bank's continuous growth in Germany, Europe, Asia, North America, and in key emerging markets is unheralded (Deutsche Bank, n.d.). The market capitalisation value for bitcoin as at 20th December, 2020 was estimated at over US$448 billion (Del Rio, 2020a). However, this was a far-cry of the market value as at 31st December, 2020 (US$540.4 billion).

Decentralised finance is an arm of cryptocurrencies that is fast gaining recognition in terms of market capitalisation value. As explained in the literature review section, decentralised finance or DeFi refers to a collection of financial services that use smart contracts; the latter are automated enforceable agreements that do not require intermediaries such as lawyers and banks in the transactions process. Between September 2017 and August 2020, the value of DeFi contracts increased from US$2.1 million (£1.6 million) to US$6.9 billion (£5.3 billion). The increase in its contracts value at the beginning of August 2020 alone was estimated at US$2.9 billion. The market capitalisation value for all tradable tokens used for DeFi smart contracts as at August 2020 was estimated at US$15 billion (Cheah, 2020). Governments and multinationals' resolve to create their unique digital coins is indicative of growing popularity of virtual currencies; and their gradual acceptance as medium of exchange and store of value in the mainstream global financial markets; and in the global business environment.

Management of crypto investment fund is becoming very competitive in the global financial space. Grayscale remained the world's leading crypto investment funds manager with more than US$5.2 billion in crypto assets as of June 2020. This included bitcoins worth US$4.4 billion during the period. Two-thirds of individuals without bank accounts have smartphones; and virtual currency

operators perceived this as an opportunity to sell digital finance to the unbanked smartphone-users' population (Cheah, 2020).

On 27th March, 2020, the United States Congress approved a US$2 trillion stimulus package to assist businesses and households. The underlying objective was to minimise the eventual effect of COVID-19 on businesses, the working population and households while stimulating the economy to avoid recession. Many financial analysts perceived the United States' economic stimulus as an incentive to revive the stock markets; and to reverse growing trends in the cryptocurrency markets. However, the stimulus package, which received Presidential assent on 28th March, 2020; and equivalent to 9.43% of the United States' GDP for 2019 (US$21.2 trillion) could not tame fortunes of the global virtual currency markets as evidenced in the performance of bitcoin and other cryptocurrencies during the research period.

4.6 RESULTS

The objective of this research was to test two major underlying hypotheses that is, measure the extent to which bitcoin's market capitalisation value significantly influences market capitalisation value for all cryptocurrencies; and how bitcoin's market capitalisation value significantly influences global GDP value. Statistics in column 2, Table 4, and Figure 7 depict the respective annual market capitalisation values for bitcoin sampled for the research. Data in the table and figure show steady increase in annual market capitalisation values from 2013 through 2020, save 2014 and 2015 when the respective bitcoin values recorded (US$4,333,390,000 and US$6,461,998,200) were significantly less than the value recorded in 2013 (US$8,878,062,000). Data in Table 4 and Figure 7 indicate respective market capitalisation values recorded in 2019 (US$130,686,479,000), 2017 (US$231,564,000,000) and 2020 (US$540,388,962,000) are the third-, second- and first-highest in the twelve-year-old history of bitcoin in the global virtual currency markets. Figure 7 and column 3 in Table 4 present the respective annual market capitalisation values for all cryptocurrencies in the global virtual financial markets. Market capitalisation values for all cryptocurrencies in the figure and table depict steady rise from 2013 through 2020, 2014 and 2015 when there were thumps in respective values (US$5,540,000,000 and US$7,090,000,000) recorded.

Brown (2020) estimated market capitalisation value for global cryptocurrency holdings in 2020 at US$335 billion, equivalent to £258 billion, which is equivalent to 44.31% of the value (756.1 billion) estimated by De Best (2020) as displayed in Table 4. Data in Table 3, column 4 depict an estimated market capitalisation value of US$199.689 billion for bitcoin during the period. These figures suggest bitcoin constituted about 59.61% ((US$199,689,000,000÷ UD$335,000,000,000) x 100% = 0.5960866 x 100% = 59.609 = 59.61%) of global market capitalisation value estimated for all cryptocurrencies by Brown (2020) during the period. The analysis suggests Brown's (2020) estimated market capitalisation value for global cryptocurrency holdings in 2020 may hold for the third quarter; and not year-end, 2020. The relatively high share of bitcoin (about 59.61%) in market capitalisation value for all cryptocurrencies affirmed the assertion by The European Business Review (2020) that bitcoin controls over 40% of the global cryptocurrency markets.

Trend analysis of the data in Figure 7 indicate a relation between market capitalisation values for bitcoin and all cryptocurrencies; market capitalisation values for all cryptocurrencies increase as bitcoin values surge, vice versa. Consistent with bitcoin values, the respective first-, second- and third-highest market capitalisation values for all cryptocurrencies were recorded in 2020 (US$756,060,000,000), 2017 (US$566,260,000,000) and 2019 (US$237,100,000,000). Data in Table 4 and Figure 7 were obtained from Statista.com. Data for the analysis in this section were limited to 2013 through 2020 because available annual market cap data on all cryptocurrencies accessed from Statista.com commenced from 2013. Causal relationship between the independent variable (annual bitcoin market capitalisation value) and the dependent variable (annual market

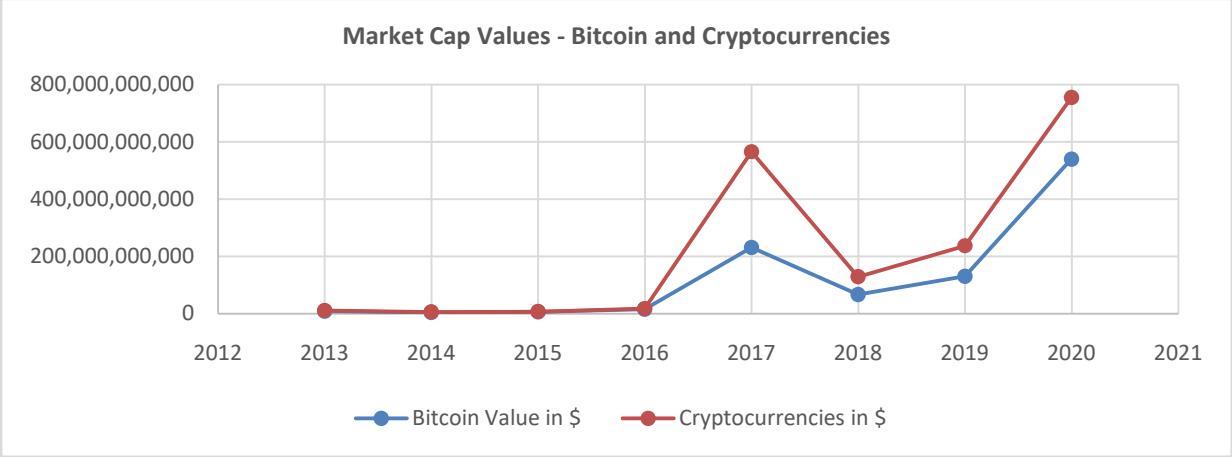
capitalisation value for cryptocurrencies) was tested using regression analytical tools. Results from the analysis are presented in the following section.

Table 4: Market Capitalisation Values for Bitcoin and All Cryptocurrencies

Year	Bitcoin Value in $	Cryptocurrencies in $
2020	540,388,962,000	756,060,000,000
2019	130,686,479,000	237,100,000,000
2018	66,842,225,000	128,780,000,000
2017	231,564,000,000	566,260,000,000
2016	15,575,409,600	17,700,000,000
2015	6,461,998,200	7,090,000,000
2014	4,333,390,000	5,540,000,000
2013	8,878,062,000	10,620,000,000

OECD (2020) defined GDP as the standard measure of value-addition which is created through the production of goods and services in a given economy during a specified period. Generally, the global economy has three major sectors. This implies determination of gross domestic product for the global economy is dependent on computation of economic activities in three distinct sectors, including agricultural, industrial and services sectors. The sum of production activities in these sectors or the total amount spent on final goods and services by governments, corporate bodies and individuals minus imports constitutes total GDP for a given financial year. The CIA World Factbook (as cited in IndexMundi, 2020) defined production activities in the agricultural sector to include forestry, farming and fishing. The industrial sector has the following production activities: construction, mining, energy production and manufacturing whereas the services sector comprises finance, communications, transportation, government activities and other private economic activities that do not result in the production of material goods.

Figure 7: Market Capitalisation Values of Bitcoin and All Cryptocurrencies



Data in column 3, Table 5, and Figure 8 depict annual global GDP values at current prices for the financial years 2012 through 2020. Analysis of annual global GDP values in the table using the incremental or year-on-year approach revealed steady increase in yearly global GDP values from 2013 (5.21%) through 2019 (4.60%); and a thump in 2020 (-2.57%). Annual global GDP value for 2020 (US$138,352,380,000,000) in the table was projected. The projected global GDP for 2020 (US$138,352,380,000,000) implied annual global GDP for the 2020 financial year was expected to fall-short of the value for 2019 (US$142,005,650,000,000) by US$3,653,270,000,000

(US$138,352,380,000,000 - US$142,005,650,000,000 = -US$3,653,270,000,000). This implied a decline in annual global GDP value between 2019 and 2020 by negative 2.57% ((US$138,352,380,000,000 - US$142,005,650,000,000) ÷ US$142,005,650,000,000) x 100% = -US$3,653,270,000,000 ÷ US$142,005,650,000,000) x 100% = -0.02572622 x 100% = -2.572622 = -2.57%).

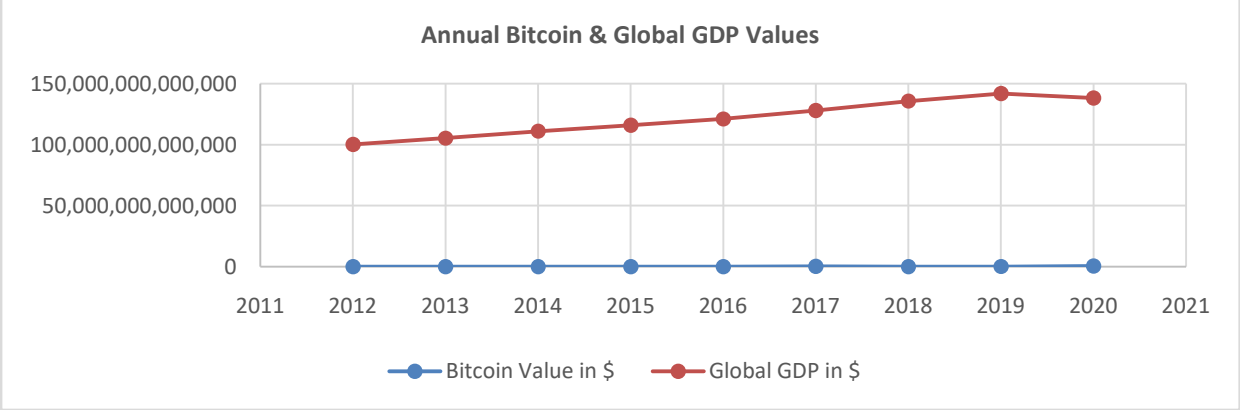
A general decline in performance of the global economy in 2020 could be attributed mainly to the COVID-19 outbreak and its attendant effect on economic activities and output in individual countries; and by extension, on the global economy. In 2020, COVID-19 impacted negatively on production activities in over 213 countries and territories across the globe (Worldometer, 2020). Respective percentage increases in annual global GDP values for the other financial years were computed and estimated as follows: 2014 (5.41%); 2015 (4.44%); 2016 (4.39%); 2017 (5.75%); and 2018 (6.03%).

Table 5: Annual Bitcoin and Global GDP Values

Year	Bitcoin Market Cap Value in $	Global GDP in $
2020	540,388,962,000	138,352,380,000,000*
2019	130,686,479,000	142,005,650,000,000
2018	66,842,225,000	135,762,140,000,000
2017	231,564,000,000	128,046,900,000,000
2016	15,575,409,600	121,089,820,000,000
2015	6,461,998,200	115,998,690,000,000
2014	4,333,390,000	111,065,560,000,000
2013	8,878,062,000	105,367,700,000,000
2012	143,341,100	100,154,940,000,000

Quarterly bitcoins circulated and quarterly bitcoin market capitalisation values were assumed to be cumulative during the research period. As a result, fourth quarter bitcoin market capitalisation value, which is a product of fourth quarter bitcoins circulated and fourth quarter per-token price of bitcoin was assumed to be representative of annual bitcoin market capitalisation value; and was therefore employed in the analysis. Stated differently, annual market capitalisation values for bitcoin in column 2, Tables 4 and 5, were derived from the fourth quarter values in Table 3, column 4.

Figure 8: Annual Bitcoin and Global GDP Values



Shared data in Tables 4 and 5 indicate the second-highest market capitalisation value for bitcoin (US$231,564,000,000) was recorded in 2017. Incidentally, 2017 was the year in which bitcoin

recorded the highest-ever value per token (US$20,000.00), although it ended the fourth quarter with per-token value of US$13,800.00; and circulated bitcoins of 16,780,000 as shown in columns 3 and 2 in Table 3. Data in Table 5 and Figure 8 were useful in testing significance of annual bitcoin market capitalisation values to the world's annual gross domestic product values during the research period. Data in the table and figure were obtained from Statista.com and databases of the World Bank, IMF and OECD.

4.6.1 Test of Hypothesis One

The alternative hypothesis under the first hypothesis in section 3.4.1 sought to test whether or not annual bitcoin market capitalisation value has strong effect on annual market capitalisation value for all cryptocurrencies in the global virtual financial markets. Output from the statistical analysis on research hypothesis one is presented in the following section.

4.6.1.1 Model Summary

Regression analysis outputs on the first hypothesis are presented in Tables 6 through 9; and in Figures 9 and 10. To reiterate, summary constitutes an important aspect of a regression model. Table 6 presents an overall description of the regression model. Values for R, R^2, and adjusted R^2 are displayed in the table. Value of the multiple correlation coefficients between the independent variable (annual bitcoin market capitalisation value) and the dependent variable (annual market capitalisation value for all cryptocurrencies) is presented in the R row. The table indicates the number of observed values in the analysis is 8. The R^2 value in Table 6 tells us the extent to which variability in the dependent variable is accounted for by the independent variable. The R^2 value implies bitcoin accounts for about 92.01% (0.920115897 x 100% = 92.0116% = 92.01%) of the variation in market capitalisation values for all cryptocurrencies. The results suggest less than 8% (100% - 92.01% = 7.99%) of the outcome is explained by external random factors. The statistical results tell us less than 8% of variation in market capital values for all cryptocurrencies is explained by the over two thousand other digital currencies in the global virtual financial markets.

Table 6: Summary Output

Regression Statistics	
Multiple R	**0.959226718**
R Square	**0.920115897**
Adjusted R Square	**0.90680188**
Standard Error	**88768.0479**
Observations	**8**

One of the measures that determine generalisability of the regression model is the adjusted R^2. Generally, an ideal adjusted R^2 value is closer to zero or the R^2 value. The adjusted R^2 value (0.90680188) in Table 6 is not significantly different from the observed value of R^2 (0.920115897). This implies cross-validity of this regression model is good; the model may accurately predict the same dependent variable from the given independent variable in a different group of participants (Field, 2009). The R^2 significance was computed to cross-validate the value (69.10881) in Table 7 using an F-ratio. The ideal F-ratio formula for measuring R^2 significance is:

$$F = \frac{(N - k - 1)}{k(1 - R^2)} R^2$$

Where:

R^2 = Unadjusted value

N = Number of cases or participants in the study
k = Number of independent variables in the regression model

Value for the F-ratio was determined as follows:

$$F = \frac{(8 - 1 - 1)\ 0.920115897}{1\ (1 - 0.920115897)}$$

$$= \frac{5.520695382}{0.079884103}$$

$$= \boldsymbol{69.10881}$$

Our computations revealed the change in the amount of variance that can be explained gives rise to an F-ratio of 69.10881, which is equivalent to the F-value (69.10881) in Table 7. This F-ratio shows a significant value ($p = 0.000$, $p < 0.05$) as presented in Tables 7 and 8.

4.6.1.2 ANOVA

The analysis of variance (ANOVA) helps to determine whether or not regression analysis provides better and significant prediction on the outcome than the mean. Data in Table 7 show degrees of freedom (between) of 1 (2 - 1 = 1); degrees of freedom (within) of 6 (8 - 2 = 6); total degrees of freedom (df) of 7 (8 - 1 = 7), and an F-value of 69.10881.

Table 7: ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.44561E+11	5.4456E+11	69.10881	0.00016432
Residual	6	47278597963	7879766327		
Total	7	5.9184E+11			

Further, statistics in Table 7 depict the model sum of squares (SSM) value, represented by *Regression*; the residual sum of squares (SSR) value, represented by *Residual*; the total sum of squares (SST) value, represented by *Total*; and the degrees of freedom (df) for each group of squares. The degree of freedom for the SSM is 1, comprising the one independent variable (annual bitcoin market capitalisation value). The sum of squares divided by the degrees of freedom gives us the mean squares (MS). That is, 5.44561E+11 (544561280424.278) ÷ 1 = 5.44561E+11.

Table 8: Model Parameters

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	27506.71596	38728.12871	0.71025161	0.504205	-67257.60116	122271.0331
X Variable 1	1.501991851	0.180676166	8.31317092	0.000164	1.059893199	1.944090503

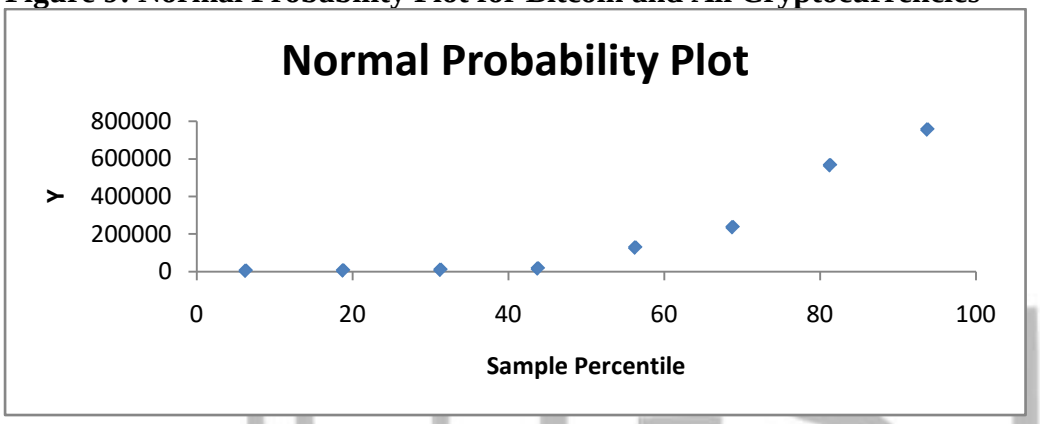
4.6.1.3 Model Parameters

A normal probability plot on the relationship between annual bitcoin market capitalisation value and annual value for all cryptocurrencies is presented in Figure 9. The figure depicts flat distribution of comparative values over a four-year period; and steady rise in comparative market capitalisation values over the remaining four-year period. Flat distribution of comparative values was recorded from the 6.25^{th} to the 43.75^{th} percentile while a steep rise was observed from the 56.25^{th} to the 93.75^{th} percentile for the normal probability. Table 8 presents results on the parameters of the regression model. Data in Table 8 show the coefficients, standard error, test statistic, significance,

and confidence intervals for the coefficients. The coefficients in Table 8 hint us on the contribution of the independent variable (annual bitcoin market capitalisation value) to the regression model.

Generally, a positive coefficient connotes a positive relationship between the independent variable and the dependent variable; a negative value is indicative of a negative relationship between the two variables. Results in Table 8 show a positive coefficient value (1.501991851). This means there is a positive relationship between annual bitcoin market capitalisation value and annual value for all cryptocurrencies. Further, relationship between the two variables is significant ($p = 0.000$, $p < 0.05$); the results suggest annual bitcoin market capitalisation value has significant influence on annual market cap value for all cryptocurrencies. This validates to a large extent, the authenticity of high annual market capitalisation data churned out for bitcoin trading in the global virtual currency markets.

Figure 9: Normal Probability Plot for Bitcoin and All Cryptocurrencies

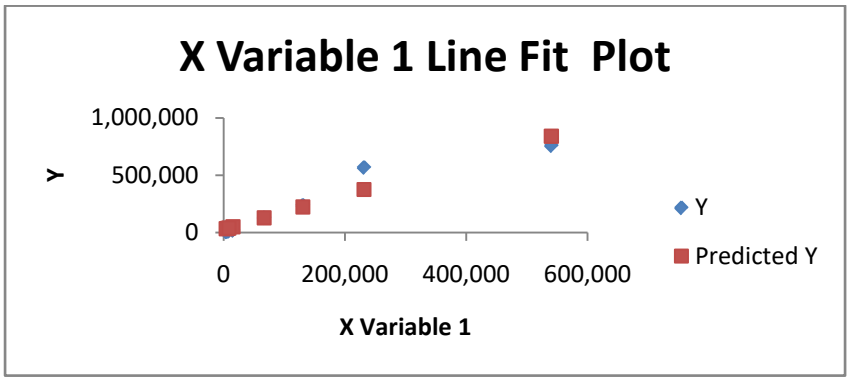


The magnitude of the t-test in Table 8 tells us the independent variable (annual bitcoin market capitalisation value) has strong impact on the dependent variable (annual market capitalisation value for cryptocurrencies). A standard error is identified with the coefficients in the table. The standard error shows the extent to which the coefficients would vary in different research samples (Field, 2009). Data in Table 8 depict the respective Upper and lower 95% confidence interval values for the *Intercept* (122271.033079758 and -67257.60116) and *X Variable 1* (1.94409050295316 and 1.059893199).

4.6.1.4 Test of Assumptions

Statistical tests were conducted to determine linearity of the relationship between the independent variable (annual bitcoin market capitalisation value) and the dependent variable (annual market capitalisation value for cryptocurrencies); and to measure the variance in residual values. The statistical outputs are presented in Figure 10 and Table 9. The scatter plots in Figure 10 are on a straight line. This affirms relationship between the independent variable and dependent variable is linear; it implies the model fits the analysis.

Figure 10: Linear Relationship between X and Y Variables



The *residual* values in Table 9 allow us to test the *homoscedasticity* of the model. That is, whether or not the residual values at each level of the independent variable depict constant variance. Residuals in Table 9 show constant variance values. This implies the assumption of homoscedasticity is met. Further, data in Figure 10 indicate relationship between the X and Y variables were measured at the interval level and beyond while variability of the dependent variable (annual market capitalisation value for cryptocurrencies) was not constrained. The foregoing analysis indicates most of the assumptions have been met; this renders the regression model fit and appropriate for the research.

Table 9: Predicted Y Values and Residual Values for Variable X

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	839166.5903	-83106.59026	-1.0112352
2	223797.525	13302.47503	0.16186359
3	127902.8553	877.1447452	0.01067304
4	375313.9569	190946.0431	2.32341821
5	50900.23904	-33200.23904	-0.4039782
6	37212.5873	-30122.5873	-0.3665296
7	34014.84665	-28474.84665	-0.34648
8	40841.39961	-30221.39961	-0.3677319

4.6.1.5 Report on P -Value and Confidence Interval

Table 8 depicts *P*-value of 0.000 and positive coefficient value of 1.501991851. These values are significant at Alpha level $\alpha = 0.05$. The table further shows a confidence interval of 1.059893199 and 1.944090503. The Alpha level, a priori, for this study is $\alpha = 0.05$. This implies there is a 5 per cent probability that we would be wrong; there is a 5 per cent likelihood the population mean would not fall within the interval (Ashley et al.; Bowerman & O'Connell, 2004; Frankfort-Nachmias and Nachmias, 2008). However, we are 95% (100% - 5%) certain our conclusions would be right. Again, the Microsoft Excel output in Table 7 shows degrees of freedom (between) of 1 (2 - 1 = 1); degrees of freedom (within) of 6 (8 - 2 = 6); total degrees of freedom (df) of 7 (8 - 1 = 7), and an F-ratio of 69.10881. These values could be interpreted as:

$$F\ (1, 6) = 69.10881,\ p < 0.05,\ \textit{two-tailed.}$$

4.6.1.6 Interpretation and Rejection of Null Hypothesis

The foregoing results indicate bitcoin has strong influence on all cryptocurrencies. Therefore, we reject the null hypothesis (Ho: $\mu_1 = \mu_2$) which states annual bitcoin market capitalisation value has no strong effect on annual market capitalisation value for cryptocurrencies, and accept the

alternative hypothesis (H_1: $\mu_1 \neq \mu_2$) which states annual bitcoin market capitalisation value has strong effect on annual market capitalisation value for cryptocurrencies.

4.6.2 Test of Hypothesis Two

The alternative hypothesis under the second hypothesis in section 3.4.2 sought to test whether or not annual bitcoin market capitalisation value has significant effect on annual global GDP value. Results from the statistical analysis on research hypothesis two are presented in the following section.

4.6.2.1 Model Summary

Regression analysis outputs on the research hypothesis are presented in Tables 10 through 13; and in Figures 11 and 12. Summary constitutes an important aspect of a regression model. Table 3 presents an overall description of the regression model. Data in the table indicate 9 values were observed in the analysis. Values for R, R^2, and adjusted R^2 are displayed in the table. Value of the multiple correlation coefficients between the independent variable (annual bitcoin market capitalisation value) and the dependent variable (annual global GDP value) is presented in the R row. The R^2 value tells us the extent to which variability in the dependent variable is accounted for by the independent variable. The R^2 value in Table 10 implies annual bitcoin market capitalisation values account for about 24.87% (0.248710234 x 100% = 24.87102% = 24.87%) of the variation in annual global GDP values. The results suggest 75.13% (100% - 24.87% = 75.13 %) of the outcome is explained by external random factors.

The extent of influence of annual market capitalisation values for bitcoin on annual global GDP values (about 25%) suggests the absence of strong cyber-security measures in the global virtual financial space to minimise frequency and success of attacks on virtual exchanges and their technological platforms could have dire investment and financial implications for the global economy; and dire implications for development and growth of the latter. However, further analysis in the following section would help determine and accentuate or otherwise, significance of the independent variable's (annual market capitalisation value for bitcoin) influence on the dependent variable (annual global GDP values).

Table 10: Summary Output

Regression Statistics	
Multiple R	**0.498708566**
R Square	**0.248710234**
Adjusted R Square	**0.141383125**
Standard Error	**13914.02178**
Observations	**9**

Again, one of the measures that determine generalisability of the regression model is the adjusted R^2. Generally, an ideal adjusted R^2 value is closer to zero or the R^2 value. The adjusted R^2 value (0.141383125) in Table 10 is significantly different from the observed value of R^2 (0.248710234). This implies cross-validity of the regression model is low; the model may not accurately predict the same dependent variable from the given independent variable in a different group of participants (Field, 2009, p. 221). The R^2 significance was computed to cross-validate the value (2.31731) in Table 11 using an F-ratio. The ideal F-ratio formula for measuring R^2 significance is:

$$F = \frac{(N - k - 1)}{k(1 - R^2)} R^2$$

Where:

R^2 = Unadjusted value
N = Number of cases, participants or observations in the study
k = Number of independent variables in the regression model

Value for the F-ratio was determined as follows:

$$F = \frac{(9 - 1 - 1)\ 0.248710234}{1\ (1 - 0.248710234)}$$

$$= \frac{1.740971638}{0.751289766}$$

$$= \boldsymbol{2.31731}$$

Our computations revealed the change in the amount of variance that can be explained gives rise to an F-ratio of 2.31731, which is equivalent to the F-value (2.31731) in Table 11. This F-ratio shows a non-significant value ($p = 0.1718$, $p > 0.05$) as presented in Tables 11 and 12.

4.6.2.2 ANOVA

In general, our ability to determine whether or not regression analysis provides better and significant prediction for the outcome than the mean is facilitated by the analysis of variance. Data in Table 11 show degrees of freedom (between) of 1 (2 - 1 = 1); degrees of freedom (within) of 7 (9 - 2 = 7); total degrees of freedom (df) of 8 (9 - 1 = 7), and an F-value of 2.31731.

Table 11: ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	448631311.2	448631311.2	2.31731	0.171755028
Residual	7	1355200015	193600002.1		
Total	8	1803831326			

Statistics in Table 11 depict the model sum of squares (SSM) value, represented by *Regression*; the residual sum of squares (SSR) value, represented by *Residual*; the total sum of squares (SST) value, represented by *Total*; and the degrees of freedom (df) for each group of squares. The degree of freedom for the SSM is 1, comprising the one independent variable (annual bitcoin market capitalisation value). The sum of squares divided by the degrees of freedom gives us the mean squares (MS). That is, 448631311.2 ÷ 1 = 448631311.188119 = 448631311.2; and 1355200014.91204 ÷ 7 = 193600002.130291 = 193600002.1.

Table 12: Model Parameters

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	116484.634	5878.399853	19.81570442	2.08E-07	102584.4271	130384.8408
X Variable 1	43.11477029	28.32265518	1.522271482	0.171755	-23.85766701	110.0872076

4.6.2.3 Model Parameters

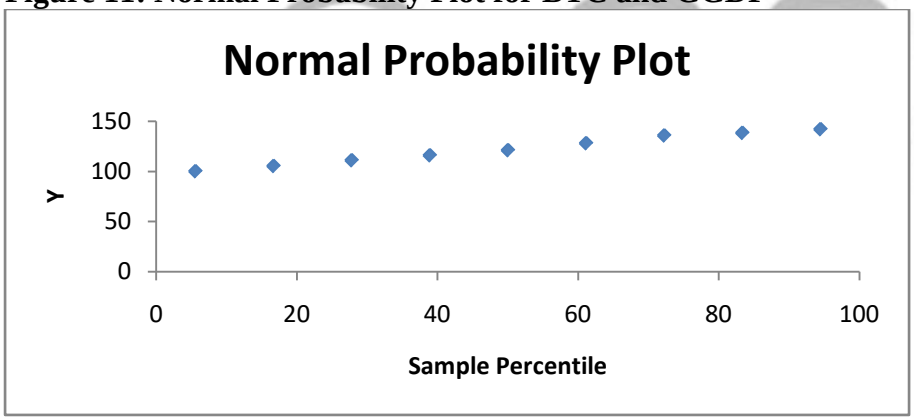
A normal probability plot on the relationship between annual market capitalisation values for bitcoin (BTC) and annual global GDP (GGDP) values is presented in Figure 11. The figure depicts steady rise in comparative values over the research period. Table 12 presents results on the parameters of the regression model. Data in the table show the coefficients, standard error, test statistic, significance, and confidence intervals for the coefficients. The coefficients announce

contribution of the independent variable (annual market capitalisation value for bitcoin) to the regression model. Generally, a positive coefficient value connotes a positive relationship between the independent variable and the dependent variable; a negative value affirms a negative relationship between the two variables. Results in Table 12 show a positive coefficient value (43.11477029). This means there is a positive relationship between annual market capitalisation value for bitcoin and annual global GDP value.

Relationship between the two variables, independent and dependent variables, is not significant ($p = 0.1718$, $p > 0.05$); the results suggest annual market capitalisation value for bitcoin has no significant influence on annual global GDP value. Thus, annual market capitalisation value for bitcoin does not suffice to determine annual global gross domestic product value, controlling for contributions of the agricultural and industrial sectors; and other activities in the services sector at the global level.

The magnitude of the t-test ($p = 0.1718$, $p > 0.05$) in Table 12 tells us the independent variable (annual market capitalisation value for bitcoin) has minimal influence on the dependent variable (annual global GDP value). A standard error is identified with the coefficients in the table. The standard error shows the extent to which the coefficients would vary in different research samples (Field, 2009). Data in Table 12 show respective Upper and lower 95% confidence interval values for the *Intercept* (130384.8408 and 102584.4271) and *X Variable 1* (110.0872076 and -23.85766701).

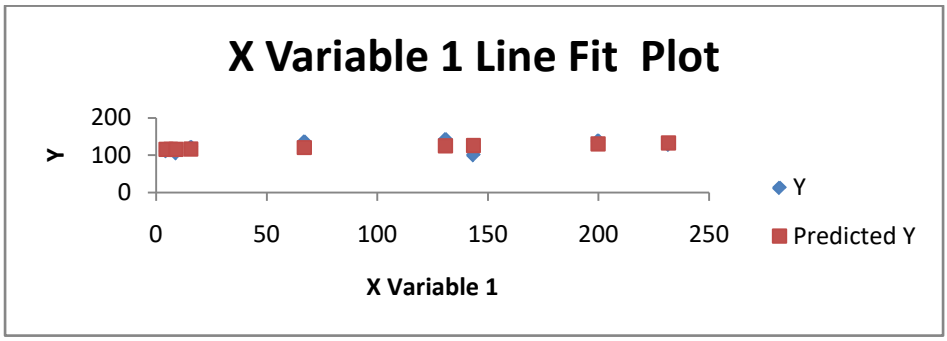
Figure 11: Normal Probability Plot for BTC and GGDP



4.6.2.4 Test of Assumptions

Statistical tests were conducted to determine linearity of the relationship between the independent variable (annual market capitalisation value for bitcoin) and the dependent variable (annual global GDP value); and to measure the variance in residual values. The statistical outputs are presented in Figure 12 and Table 13. The scatter plots in Figure 12 are on a straight line. This implies relationship between the independent variable and dependent variable is linear; it infers the model fits the analysis.

Figure 12: Linear Relationship between X and Y Variables



The *residual* values in Table 13 allow us to test the *homoscedasticity* of the model. That is, to test whether or not the residual values at each level of the independent variable depict constant variance. Residuals in Table 13 show constant variance values. This implies the assumption of homoscedasticity is met. Further, data in Figure 12 indicate relationship between the X and Y variables were measured at the interval level and beyond while variability of the dependent variable (annual global GDP value) was not constrained. The foregoing analysis indicates most of the assumptions have been met. This renders the regression model fit and appropriate for the research.

Table 13: Predicted Y Values and Residual Values for Variable X

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	139766.6099	-1414.229912	-0.108658402
2	122119.1515	19886.49852	1.527923522
3	119366.5211	16395.61887	1.259711543
4	126468.4626	1578.437378	0.121274824
5	117156.1642	3933.65584	0.30223145
6	116763.2415	-764.5515214	-0.058742179
7	116671.4671	-5605.907068	-0.430714199
8	116867.4096	-11499.70956	-0.883548037
9	122664.7526	-22509.81255	-1.729478523

4.6.2.5 Report on P -Value and Confidence Interval

Table 12 depicts respective *P*-value of 0.1718 and positive coefficient value of 43.11477029. These values are not significant at Alpha level $\alpha = 0.05$. The table further shows a confidence interval of -23.85766701 and 110.0872076. The Alpha level, a priori, for this study is $\alpha = 0.05$. The inference is there is 5 per cent probability that we would be wrong; there is 5 per cent likelihood the population mean would not fall within the interval (Ashley et al.; Bowerman & O'Connell, 1990; Frankfort-Nachmias and Nachmias, 2008). However, we are 95 per cent (100% - 5%) certain our conclusions would be right. Again, the Microsoft Excel output in Table 11 shows degrees of freedom (between) of 1 (2 - 1 = 1); degrees of freedom (within) of 7 (9 - 2 = 7); total degrees of freedom (df) of 8 (9 - 1 = 8), and F-ratio of 2.31731. These values could be interpreted as:

$$F\ (1, 7) = 2.31731,\ p > 0.05,\ \textit{two-tailed.}$$

4.6.2.6 Interpretation and Rejection of Alternative Hypothesis

Outcomes of the foregoing analysis indicate annual bitcoin values have minimal effect on annual global GDP values. Therefore, we reject the alternative hypothesis (H_1: $\mu_1 \neq \mu_2$) which states annual bitcoin market capitalisation value has significant effect on annual global GDP value, and

accept the null hypothesis (Ho: $\mu_1 = \mu_2$) which states annual bitcoin market capitalisation value has no significant effect on annual global GDP value.

5.0 RECOMMENDATIONS

Discussions throughout the preceding sections revealed major common thread and desideratum. That is, the existence of teething challenges that could undermine successful adaption and implementation of bitcoin and altcoins for rapid development of the financial sub-sector of most economies to enhance the contribution of cryptocurrencies to growth in the services sector; and to accelerate real growth in national gross domestic product. Deficiencies in effective development of the services sector of individual economies could have serious negative implications for contribution of the global financial markets, including virtual financial markets to global GDP. On the basis of the foregoing, the following recommendations are proffered.

- Contrary to the expectations of Nay-Sayers, the research revealed exponential development of bitcoin in the global virtual financial markets; and its major role in asserting the influence of cryptocurrencies on the mainstream global financial system. This is remarkable in bitcoin's relatively few years of existence. The foregoing is affirmed by findings from the current research which revealed market capitalisation values for bitcoin account for about 25% of the variation in global GDP values. Though not statistically significant ($p = 0.1718$, $p > 0.05$), it is tremendous improvement over the role of bitcoin in determination of global GDP values as of 2018 (Ashley, 2018). The research findings are consistent with extant research (Brown, 2020; Cheah, 2020; Del Rio, 2020; Jorner, 2020; Licardo, 2020; Potts and Rennie, 2020; and Urquhart, 2020) which argued bitcoin and other cryptocurrencies have come to stay not only in the global virtual financial markets but also in the mainstream global financial markets and systems. The exponential rate of development of bitcoin and other cryptocurrencies makes it imperative for individual economies to review their respective perception of and stance on bitcoin and altcoins. Rather, they must identify ways in which they could effectively incorporate cryptocurrencies' trading and related activities into their respective financial sub-sector laws and regulations. The evidence suggests any attempt to ban trading in cryptocurrencies, including bitcoin in its entirety may be financial and technological exercise in futility. However, what could be assured is an attempt by governments of various countries and territories to regulate trading in digital currencies. Thus, the focus and emphasis of various governments should be on regulation of cryptocurrency activities; and not imposition of ban on same.

- Numerical count of countries and territories during the COVID-19 outbreak in 2020 revealed the global economy comprises over two hundred and fifteen (215) countries and territories. As part of global efforts at countering money laundering and financing of terrorism, the Financial Actions Task Force was established at the inter-governmental level to play a watchdog-role; and to set global standards to guide local and international financial transactions to prevent illicit business transactions. Specifically, FATF was established to formulate policies at the international level to combat the finance of terrorism and money laundering. To this end, the global financial watchdog periodically reviews its standards to reflect novel strategies and techniques used by money launders and financiers of terrorism; and periodically strengthens its standards to address emerging risks in the regulation of virtual assets. Given the strategic role of FATF in the success of global financial markets and systems; and by extension the global economy, it is recommended that membership to the Financial Actions Task Force is extended to include the over 215 countries and territories around the world. Thus, countries and territories that are yet to commit to the noble cause of FATF are entreated to do so to assure uniformity in global regulatory

standards for digital currencies and their related transactions to facilitate their universal acceptance; and to achieve the underlying objective for the introduction of bitcoin and other cryptocurrencies. That is, to eliminate transactions and payments bottlenecks inherent in the traditional financial systems across the globe.

- Countries such as the United Arab Emirates, Zimbabwe and Nigeria that hitherto expressed outright prohibition of bitcoin and altcoins trading have been impelled to review their original position. For instance, Ashley (2018) reported in 2017, businesses in Nigeria were compelled to seek financial refuge in bitcoin when the economy was plunged into recession, resulting in fall in value of the local currency; and the Nigerian government restricting businesses' access to the American dollar as a strategic way of salvaging the economy from total collapse. Further, Aelex.com (2020) noted Buycoins, a virtual exchange platform operating in Nigeria was able to process more than N500 million worth of virtual currencies in three months. Exigencies of the time in terms of rapid spread of bitcoin and altcoins trading have impelled many countries to either publicly denounce trading in cryptocurrencies including bitcoin; or institute measures to ensure regulation of same in their respective jurisdictions. The portent ability of COVID-19 to confine global leaders and their citizens to their respective countries and homes further underscored the importance of digital currencies in the global virtual and mainstream financial space. Countries that fail to appreciate and quickly embrace cryptocurrencies including bitcoin for implementation could be likened to individuals or groups with strong preference for desktop computers; and not willing to change to use of laptops and other improved versions of the device. To wit, countries must strive to contribute meaningfully to the progress needed in the global financial space through improved ***financial digital transformation***.

- The Financial Actions Task Force (2020) noted widespread of virtual assets across the globe, following increased popularity of cryptocurrencies in recent years. Annual Report issued for 2019-2020 by FATF revealed the commitment of over two hundred (200) countries and territories to the implementation of its Policy Standards. This number is a significant improvement over the thirty-seven-member countries reported by Salami (2020b) as of 27th March, 2020. Standards set by FATF provides clarity for status and roles of digital exchanges and other businesses providing services in the virtual financial space. Further, effective implementation of FATF regulations eliminates doubt and facilitates approval of transactions between banks and virtual financial market operators. This is evidenced in revised and newly-approved regulations in South Korea, Singapore, United Arab Emirates, Germany, France, and elsewhere. Reduction in the level of anonymity and privacy would minimise use of bitcoins and other cryptocurrencies for criminal activities. Countries such as Zimbabwe and Nigeria are drawing on the *Fintech roadmap* to emerge with respective regulatory frameworks that would facilitate trade in digital currencies in their respective economies. Other African countries including Ghana that are dormant in the enactment of legislation to guide and regulate the activities of bitcoin and altcoins traders must emulate the examples of Zimbabwe and Nigeria by reactivating and ensuring expeditious completion of their respective regulatory frameworks.

- Realisation of set objectives is at the heart of the Financial Actions Task Force. To this end, FATF constantly monitors member-countries and territories to ensure full and effective implementation of its standards. It also holds countries and territories that do not comply accountable. To effectively tame security-threats to the global virtual financial systems, FATF would require the concerted efforts of both member- and non-member countries. Governments of various economies could complement the efforts of FATF by introducing

measures that would strengthen and enhance their respective anti-money laundering and know-your-customer controls, among other essential requirements. Stated in different terms, governments of various countries and territories must ensure effective implementation of the regulatory mechanisms developed by FATF at the inter-governmental level to increase transparency while limiting the extent of privacy associated with bitcoin and altcoins transactions in the global virtual financial markets. This would contribute to significant reduction in substantial investment losses to predatory hackers in the virtual exchange markets while neutralising the activities of money launderers and financiers of terrorism.

- Consistent with current cryptocurrencies' legislation in South Korea, regulatory frameworks and measures of various governments must be developed to include use of names in the transactions processes. This would assure safety and minimise risk inherent in virtual currency transactions. Use of real names in accounts openings could enhance the financial relationship between physical and virtual banks on one hand, and virtual exchange operators on the other. Use of real names would help regulatory bodies keep track of transaction flows; and to identify with relative ease, account holders who engage in illicit financial transactions such as money laundering. Thus, reduction in the level of anonymity and privacy could be a recipe for increased transparency and minimal use of bitcoins and other cryptocurrencies for unapproved social and financial activities.

- Lack of central bank control, tax evasion, weakening and possible replacement of national fiat currency were identified as some of the cardinal factors accounting for various governments' reluctance to officially recognise and accept the operations of cryptocurrency exchanges in their respective jurisdictions. However, dynamics in the virtual and mainstream global financial space support universal recognition and acceptance of bitcoin and other cryptocurrencies at an exponential rate. This underscores the need for governments of various economies to up their respective games on regulatory frameworks for cryptocurrencies, so they are not left behind. In order to be abreast of and keep up with the pace of changing dynamics in the global virtual financial markets, governments must ensure digital currency exchanges and agents operating within their jurisdictions register with their central banks or the relevant regulatory bodies; and the regulator must keep records of the virtual exchange operators and agents. Registration of virtual exchanges would address the issues of control, tax evasion and possible replacement of national fiat currency; and reduce the incidence of cryptocurrency firms running away with coins and funds of investors.

- Role of the Financial Actions Task Force in developing policies and standards to guide and regulate crypto-assets management and trading at the global level; and monitoring of member-countries and territories for compliance increase the responsibilities of governments at the national level. It is incumbent on various governments to ensure the activities of digital currency traders are in sync with global standards. It is quite difficult for governments to adapt a laissez-faire approach to regulation of cryptocurrency trading at this stage. Indeed, effective legislation at the national level would complement the role and efforts of FATF at the global level. This notwithstanding, effective regulation of decentralised systems of virtual exchange markets remains a strong challenge to global economies. To improve on the security threats and regulation of virtual financial systems, it is imperative for global economies to invest heavily in technology experts; and to engage with key stakeholders including system-developers and miners. Massive investment in technology by governments to enhance understanding of the complex mathematical systems

of digital exchanges would ensure security agents keep a constant trail on criminals; and provide the requisite protection for investors' funds (Ashley, 2018).

- Stable virtual financial system is analogous with thriving financial sub-sector; and analogous with strong national output in the form of increased gross domestic product. This argument clearly supports calls for various stakeholders, including system developers and miners to make investment in and development of virtual financial platforms and markets a priority in their respective economies. The investments in technology are needed to enhance security measures, so the funds of investors could be protected from predatory system-hackers. Blockchain technology and Bitcoin network managers must endeavor to distinguish system signal from noise (Glance, 2013), which could be malware introduced by predatory hackers to corrupt and access their respective systems and platforms; and to steal valuable bitcoins and other cryptocurrencies. There is no gain-saying proactive, rather than reactive steps and measures of various governments and virtual exchange operators are required to curb system-hacks currently; and in the near and distant future.

- Although there is a clarion call for various governments to make massive investments in infrastructure development for virtual financial systems a top priority, Ashley (2018) argued it is imperative for some analysis to precede the investment decisions. It is instructive for the necessary cost-benefit analysis to be diligently carried out by various governments before introducing regulations and actively involving themselves in the activities of cryptocurrencies trading. If the cost of regulating the digital currency market in terms of administrative and security costs would outweigh eventual revenue to be derived from the activities of investors and traders over a long period, it may not be economically productive to pursue it, vice versa. The foregoing might have formed the basis for some economies' decision to impose outright ban on trading in cryptocurrencies in their jurisdictions over the years. This is especially so when it is difficult for various governments to control the activities of digital currency operators through their respective central banks to derive tax revenues. However, the significant increases in respective market capitalisation values for bitcoin (US$540.4 billion) and all cryptocurrencies (US$756.1 billion) in 2020 relative to their respective values in 2019 (Bitcoin - US$130.7 billion; All cryptocurrencies - US$237.1 billion) are indicative of a thriving virtual financial sub-sector. The data indicate the market capitalisation value for bitcoin more than quadrupled (about 4.14 times) while the value for all cryptocurrencies more than tripled (about 3.19 times) during the period. The quantitative evidence points to the emergence of a global virtual financial sub-sector in which massive investments by various governments and digital exchange operators may not be lost, but may be recouped over a given period of time.

- Some crypto and finance experts argued the operations of virtual currency platforms and operators are shrouded in secrecy; and that, this setback makes it difficult to determine the authentication processes for their systems and investors' trading. Nevertheless, the research revealed effective system authentication prevents frequent cyber-attacks; and minimises the success rate of cyber-attacks. This accentuates indispensable role of the authentication process in the success story of virtual financial systems. Consistent with Glance (2013), the two-factor authentication process is recommended to providers of virtual financial services, especially when this medium of authentication does not exist in their glossary of authentication processes. Practically, the two-factor authentication system could deny sophisticated hackers easy access to the coin vaults of virtual exchanges. It could insure the safety of investors' funds; and whip up the enthusiasm of pessimists to embrace the virtual financial system as a game-changer in the global financial and business community. Under

the two-factor system, a compromise on password is not sufficient to access the targeted account; system-hackers need to access another device to generate second token to complete the login process. Presently, the second step remains a tall-order for system-hackers. There is the need for system developers and virtual market operators to treat all information on their digital platforms with caution until the information has been verified by a number of sources to confirm its real usefulness, other than harm to the entire digital financial systems across the globe.

- Consistent with Ashley (2018), it is recommended that measures to be adapted and implemented by governments of various economies across the globe should not cripple activities in their respective virtual currency markets. Rather, the measures should streamline and guide their respective digital markets to enhance overall contribution of the virtual financial sub-sector to their respective national developments and growths through increased gross domestic product. To reaffirm, the regulatory framework of each government should seek to deter criminals; it should not impact negatively on the activities of genuine investors. Adaption and implementation of regulatory measures without due diligence could result in criminals with strong technological leanings infiltrating and dominating the digital currency markets. When this occurs, the fundamental objective of maintaining genuine investors and attracting genuine investment prospects to the global virtual financial markets would be defeated. Instead, money laundering and funding for terrorism and its related activities would dominate the virtual financial markets globally.

- One of the altcoins in the cryptocurrency industry is ripple. The European Business Review (2020) found many elected governments and financial institutions perceive it as the best alternative to physical currency; and therefore recommended its usage in the global financial markets. Most elected governments and financial institutions walk their pronouncements with active trading in ripples in the virtual financial markets. The general attestation to the effectiveness of ripple implies the economic usefulness of cryptocurrencies such as bitcoin and ripple is not limited to developing and emerging economies, but extended to economies in the developed world. Consequently, leaders of various global economies and corporate bodies could latch on the opportunities inherent in some of these cryptocurrencies to improve on their respective national and corporate accounts through strategic hedging and investments.

- Evidence in the global virtual and mainstream financial markets points to a simple fact. That is, bitcoin and altcoins have come to revolutionise the traditional global financial systems. It is imperative for the world to look forward to the emergence of improved versions of bitcoin and altcoins, but not the dissipation of same as envisaged by opponents. The implication is, various governments and global corporate leaders must identify strategic ways to ensure they derive maximum benefits from trading in bitcoin and other cryptocurrencies as it is the case in China (utilising *digital renminbi*) and Venezuela (utilising *petro*); and JP Morgan (utilising *JPM coin*). In April 2017, Japan enacted laws to officially recognise bitcoin as a legal tender. Consistent with Ashley (2018), it is recommended that while committing to due diligence, leaders of advanced, emerging, African and other developing economies must commit to adaption and implementation of bitcoin and other cryptocurrencies to provide security for their respective national currencies, public funds, investments and debts.

- In addition to forward, futures, option and swap, economies and corporate bodies could invest in bitcoin and altcoins as derivatives; they could buy bitcoins and other cryptocurrencies to hedge against short-, medium- and long-term investments. Specifically,

governments of various global economies could invest in bitcoins or altcoins or both as a means of hedging against future national earnings and debt settlements. Returns on investment in bitcoins and other cryptocurrencies could shore up significantly, the overall GDP of any economy (be it advanced, emerging or developing economy) in a given financial year. Repayment of debts at due dates could be effected with few bitcoins and other cryptocurrencies relative to more national currency notes or the American dollar. Repayment of debts using national currency notes could negatively impact on the strength of the latter in the foreign currency markets. This investment strategy holds true for corporate and individual investors in the global digital financial markets.

- The foregoing notwithstanding, it is imperative to ascertain the credibility of chosen digital exchange or exchanges before the nation, corporate or individual's funds are committed to the investments. Such an investment at the national or corporate level may be carried out using a wallet ID and not the name of the government or corporate body. This may make it difficult for the investment or investments to be noticed; and to become a direct target for virtual financial system-hackers. However, digital currency accounts for individuals must be operated with real names for the purposes of taxation; and control of illicit trade activities. Corporate bodies could be permitted to use wallet ID for "public" transactions on the virtual exchanges to conceal their identity from system-hackers. In addition to the foregoing, corporate bodies would have to maintain real account names to ease their identification by the regulator for tax and other control purposes. It is equally important for such investments to be held for not more than two (2) years to avert the possibility of losing those investments to system-hackers. Nonetheless, the investments could be held over a long-term. However, not with the same virtual exchange to avoid possible losses. All things being equal, an investment in bitcoin is expected to double in value in a year or two. When this objective is achieved, substantial portion of the bitcoins held could be resold to realise real earnings in dollars; or relocated to another virtual exchange. Sale of substantial portion of bitcoins held should be contingent on trend analysis of its current and future trade prospects. Relatively small portion of the total amount realised from the sales could be reinvested in the original digital currency markets to guard against potential loss of investments. Alternatively, with the emergence of over 2,000 cryptocurrencies and large number of virtual exchanges, the total investment sum could be spread over several virtual exchanges (under bitcoin alone or together with other potentially-viable coins such as ethereum, bitcoin SV and ripple) to minimise usual risk associated with investing all the capital in a single cryptocurrency; and under one virtual exchange.

- Bitcoins purchased and held for investment purposes could be classified as a security; and categorised into the pool of eligible financial securities controlled by regulatory bodies in various economies. A major challenge used to be how to regulate the activities of bitcoin and altcoins traders in the "spot" or virtual markets where direct trade occurs without recourse to a specific jurisdiction. However, registration of groups and individuals engaged in the activities of bitcoin and other cryptocurrencies trading in each economy should facilitate the task of regulatory bodies. Consistent with Ashley (2018), institutions of higher learning and professional bodies across the globe are encouraged to integrate the study of bitcoin and altcoins, or cryptocurrencies into their respective business-related programmes such as *Finance, Banking, Economics, Accounting*; and any other programme that combines Finance and Banking. The concept of cryptocurrencies could be introduced as core or elective course. This would enhance individual and collective understanding of, and knowledge in the global virtual currency markets. Further, it would improve readers'

understanding of the impact of digital currency trading on individual economies and the global financial markets; and the impact on the global business environment.

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