

Analyzing the Effects of Adding Bitcoin to Portfolio

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Abstract—This paper analyses the effect of adding Bitcoin, to the portfolio (stocks, bonds, Baltic index, MXEF, gold, real estate and crude oil) of an international investor by using daily data available from 2nd of July, 2010 to 2nd of August, 2016. We conclude that adding Bitcoin to portfolio, over the course of the considered period, always yielded a higher Sharpe ratio. This means that Bitcoin's returns offset its high volatility. This paper, recognizing the fact that Bitcoin is a relatively new asset class, gives the readers a basic idea about the working of the virtual currency, the increasing number developments in the financial industry revolving around it, its unique features and the detailed look into its continuously growing acceptance across different fronts (Banks, Merchants and Countries) globally. We also construct optimal portfolios to reflect the highly lucrative and largely unexplored opportunities associated with investment in Bitcoin.

Keywords—Portfolio management, Bitcoin, optimization, Sharpe ratio.

I. INTRODUCTION

GIVEN the financial crises being faced by different countries like Hyperinflation in South America, the continuous devaluation of the Yuan, Brexit, Greece's never ending financial crisis and more, investors have been looking for alternative forms of investments and safe havens. Bitcoin, a virtual currency which was first described in 2008 in [1] by Satoshi Nakamoto (a pseudo name), now has a market capitalization of around \$10 billion despite it being a relatively new asset class.

This paper in short, analyses if it is beneficial for a layman to have Bitcoins in his/her portfolio. It does so in four sections. The first section introduces the readers to Bitcoin as a currency, covering the basics of how it is generated, what affects its prices and reasons as to why the people are so fascinated with its technology.

The remainder of the paper is organized as follows: In Section II, we deal with how Bitcoins are traded on exchanges, different market instruments related to Bitcoins and whether there exist arbitrage opportunities given the different prices on different exchanges. The third section of the paper compares the portfolio risk-return characteristics for various portfolios with and without Bitcoins, giving the readers an idea about the results of adding Bitcoins to their portfolio. The last section of this paper is meant to make users aware of the global trends in the acceptance of Bitcoins and the fact that the currency is past its nascent stage.

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A. Introduction to Bitcoins

Bitcoin, the world's first decentralized digital currency, is a cryptocurrency, "Cryptocurrency in its purest form is a peer-to-peer version of electronic cash. It allows online payments to be sent directly from one party to another without going through a financial institution." [3]. The most fascinating part is that Bitcoins which are worth hundreds of dollars are just a record of transactions available to the public and not physical coins or even files on a computer.

Despite their price volatility, Bitcoins currently have a market capitalization of over \$10 Billion, there are 15800600 [5] Bitcoins in circulation and over 8 million Bitcoin Wallet users. Let us understand the factors which set Bitcoin apart from the fiat currencies, and have been responsible for the surge in their demand.

Decentralized

Bitcoins as a currency are not regulated by a central bank like other fiat currencies. "It can be transacted with any outside agents and the governance is decentralized mainly but not necessary due to open-source software. There is no legal entity responsible for the activities, and therefore, they fall outside traditional regulation." [3]. They are generated at a constant supply rate so that the total number of Bitcoins to be ever generated will be 21 Million. The digital currency is built on peer to peer networking and relies on "Miners" and "Blockchain" to maintain its integrity.

Pseudoanonymity

The people who are involved in the transaction, i.e. the buyer and seller, both are identified through their "public and private keys." But they are not linked to real world identity like name, address etc. because Bitcoins make use of a digital signature which is generated through a different private and public key pair for every transaction. "Since there is no third-party intermediary, nobody knows their identities as well. However, unlike cash, the transaction is recorded on the blockchain. Some of the information recorded includes the public keys of the sender and recipient, the amount, and a time stamp. Every transaction in the history of Bitcoin has been recorded and will be recorded on the blockchain and is publicly viewable. While there is some privacy, the blockchain is a public record of all transactions and it may be possible for anyone to identify the parties behind them, especially if a person's identity is linked to a public key. While Bitcoins may be anonymous like cash in the sense that parties can transact without disclosing their identities, it is also unlike cash because transactions to and from any Bitcoin address can be traced. Therefore, Bitcoin is pseudonymous, not anonymous." [3]

Transparency

The entire Blockchain which is the ledger of all the transactions ever completed with Bitcoins is publicly available i.e. it is available on every node on the Bitcoin network. [3],[1]

Accessibility

Bitcoins can be converted into all the major currencies of the world (at least 32 countries)[34]. Since Bitcoins can be used in every country across the world, people have access to the global market as a whole, it is axiomatic that better ideas and higher quality of growth will ensue. [3]

Reduction in Transaction Costs

Bitcoins can be transferred directly between individuals without having to go through a checking agency or a bank or any other third party. Given that the accessing and transacting the Bitcoin network, which nobody owns, is free of cost, there is a significant reduction in the transaction costs. [3]

B. Block Chain [1]. [3]

Block Chain has been called the backbone of the Bitcoin economy and to put it in the crudest terms possible, it is a tamper-proof public ledger of all the Bitcoin transactions which have ever occurred, starting from the first transaction which was used to buy a pizza from Papa John's for 10,000 Bitcoins, to the ones happening this very second. This is completely different from a bank's ledger, which only the bank can see and this aspect adds to the transparency in the system and furthers the goal of a Decentralized currency.

The idea of sharing all your transaction details with millions of users around the world seems extremely risky to say the least, but the Block chain solves this problem very efficiently. Firstly, it uses SHA-256 cryptography which involves all the transactions going through a tedious, but a quick verification process. We'll explain the process through an example, say A has to transfer a few Bitcoins to B in exchange for some goods. This involves the following steps.

Generation of a PRIVATE KEY [1], [3]

A private key is a randomly generated number of 256 bits and can be thought of as the PIN number to your bank account. It goes without saying that it has to be kept secret and safe, because having access to someone's private key is equivalent to having access to all the Bitcoins secured by that key and losing a private key means that all the Bitcoins linked to that key will be lost (Zombie Coins). Creating a Bitcoin key is essentially the same as "Pick a number between 1 and 2^{256} ".

Generation of a PUBLIC KEY [1], [3]

A public key is linked to the private key and is generated through "Elliptic Curve Multiplication", an irreversible cryptographic function. Going with the previous analogy, it can be thought of as the bank account number

Generation of a BITCOIN ADDRESS [1], [3]

A Bitcoin address is a string of numbers and characters starting with 1 and what is made available to the public and is

generated through a one way cryptographic function from the PUBLIC KEY. And in the analogy used thus far, it will be the recipient of the funds.

Say A has to send some Bitcoins to B. Firstly A will have a new set of private key, public key and Bitcoin address generated for this transaction. So, he then signs the transaction with his private key. Then, the transaction details have to be verified, as in, whether it was A only who initiated the transaction and whether it is valid or not and this is done by using the Public Key which is available to every node on the network. It is in this process of verification of transactions that Data Miners and the process of Bitcoin Mining comes in, which is explained below. And after the verification is done, the transaction can be completed by the transfer of funds between the Bitcoin addresses of A and B. [1], [3]

C. The Verification

Bitcoin Mining [4]

Bitcoins are generated through a process called Bitcoin mining. "Miners" are the nodes on the network involved in the verification process of unconfirmed payments. What happens is that, all the miners are involved in a "lottery" and whoever wins gets to verify a "block" of unconfirmed payments and in return gets 12.5 Bitcoins as a reward. Every 4 years this reward gets halved. In 2016, it got halved to 12.5 Bitcoins. [4]

The Lottery [4]

There is a lottery based system to identify the winning miner or the pool of miners. The winner gets the rewarded with bitcoins. What happens is, there is a complex mathematical puzzle that needs to be solved using the Bitcoin mining hardware that the miners on the network have and whoever is able to solve it first announces across the whole network and after the majority of miners agree that it is the correct solution, the winning miner verifies the transaction block and hashes (basically adds) it onto the block chain and gets rewarded with 25 Bitcoins, but only after another 99 blocks have been added. The whole process repeats itself and this is how transactions are verified.

The Mathematical Puzzle [4]

Data miners' set up their data mining hardware to calculate cryptographic hash functions. Hashing means converting a string of characters of arbitrary length into a fixed length string; e.g. SHA-256 converts the characters into a 256 bit string. The mining hardware has to come up with a number called "Nonce" which when added to the end of the cryptographic hash, which is present in the block of the transactions which are to be verified, will give a new hash value. The obtained hash value will have to satisfy the requirement of having a specific number of leading zeroes. For example, say the number of leading zeroes is 39. There are 2^{39} strings possible, but only one of them is the correct one. The miner who comes up with the correct string first, gets rewarded but only after the acceptance of his solution by majority of all the miners.

Proof of Work [4]

These Nonce(s) when added to the mathematical puzzle and passed through a cryptographic hash (here SHA-256) give different hash values and the accepted Nonce i.e. the solution is the magic number. This Solution Nonce, with the whole network's power, takes on an average about 10 minutes to come up with. And this nonce is called proof of work because it proves that you actually put time and effort into solving the puzzle

What is the Difficulty of This Puzzle?

The difficulty of the mathematical puzzle is reset by the network itself after every two weeks in accordance with the improvement in technology of the Bitcoin mining hardware and the length of the block chain. This is done so as to maintain the time of being able to mine a block at around 10 minutes only. [4]

The detailed process is as follows. Bitcoin difficulty started at 1 and it keeps getting updated. We know that the time to mine 2016 blocks should be 14 days (10 mins for every

block), but due to the technological improvements, and changing hash rate on the network, the time may be different, say it is T. So, to obtain the new difficulty level, we multiply the previous difficulty level with $(2 \text{ weeks}/T)$. This is done with the belief that, if the hash rate continues to be the same, then it will take exactly 2 weeks to mine 2016 more blocks, which is the desired result. Due to a bug in the system, we currently consider 2015 blocks in the past. So in the previous example, say the difficulty level has to be increased, the simplest way to do it would be to add another leading zero because then it would lead to the number of strings you are having to go through being doubled i.e. 2^{40} . "To a layperson, Bitcoin is a digital currency that is created and held electronically. These Bitcoins are sent and received using a mobile app, computer software, or service provider that provides a Bitcoin wallet. The wallet generates an address, akin to a bank account number, except that a Bitcoin address is a unique alphanumeric sequence of characters where the user can start to receive payments" [3]

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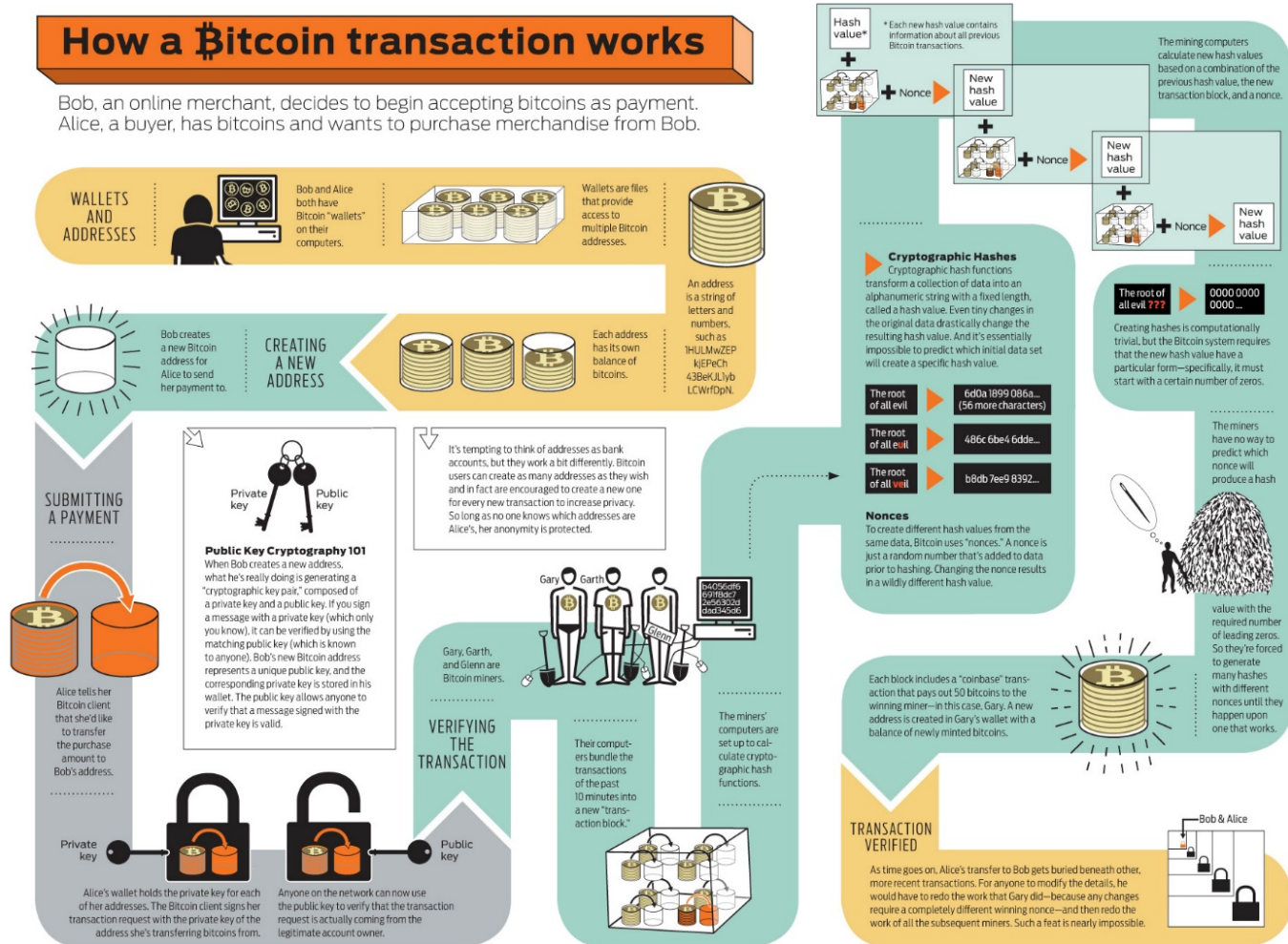


Fig. 1 How a Bitcoin transaction occurs [30]

D.An In-Depth Explanation of How Double Spending Is Avoided

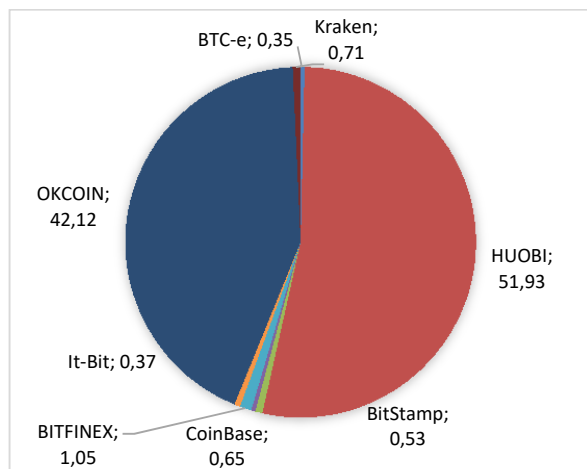


Fig. 2 Market Share of various Bitcoin Exchanges [5], [16]

We'll explain the process of double spending, and how it is avoided through Blockchain. Let's assume that A and B are involved in a transaction where A has to pay B, say 5 Bitcoins, in exchange for some goods. Now say A wants to defraud the system by double spending, i.e. she wants to use the same 5 Bitcoins for two different transactions, A to B, and say A to A (sending the money back to herself) which she thinks can happen because the next block of the verified transactions will be added after 10 mins. So how can A go about defrauding the system? Say the transaction A to B was verified by the miners and added to the block chain, but for A to be successful in her endeavor, firstly has to be incredibly lucky to be able to add another block, containing her transaction i.e. A to A, at the same time that A to B was added. Because if she adds it after the first transaction has been verified, her transaction will be rejected because those coins that she claims to still have, are now already spent and the miners across the network have that knowledge. So say, she has the power and the money and the luck to solve the mathematical puzzle before anyone else and add it at the exact same time as the previous block is verified, after that she needs to be luckier and hope that, it is her branch of the block chain to which the next block is added. This requires immense networking power and electricity, and this

scenario is highly unlikely. Or if she does not add the block at the same time then she will have to fork the chain by adding having to win the lottery and then adding the block of transactions which has the defrauding transaction and then keep on winning the lottery so that she can add more blocks to her forked chain so that this becomes the more difficult chain and is perceived as the newer block chain. To do this, she'll need to win the lottery several times consecutively, till she can beat the block-chain or basically has majority (51% power of the entire network) which is highly improbable. [9]

II. EXCHANGE PLATFORMS

Exchange platforms for Bitcoins are similar to the stock market trading platforms that we are familiar with; except they function 24/7. These platforms are becoming popular by the day. To give an example, Bitcoin Mercantile Exchange (BitMEX), launched in 2014 already has over 5,800 users who have traded more than \$760 million on the exchange [35]. In a recent show of acceptance of Bitcoin by the financial world, on May 2, 2016, the CME group which is the world's most diverse marketplace for derivatives, along with Crypto Facilities Limited announced the plan to develop two new products, which will provide benchmark rates for Bitcoins:

1. "Bitcoin Reference Rate (BRR) will provide the final settlement price in USD at 4 pm London time on each trading day."
2. "CME CF Bitcoin Real Time Index (RTI) will allow users real time access to Bitcoin prices." [6]

TABLE I
 A COMPARISON OF THE MAJOR BITCOIN EXCHANGES [7]

Exchanges	Currency	Price (\$)	Market Share (%)	Fees
BTC-e	USD	578.64	0.35	0.2-0.5%
HUOBI	USD/CNY	585.58	51.93	.08 - .2 %
CoinBase	USD	583.48	0.65	No fee to receive BTC or transfer more than .0001 BTC. 1% fee to convert BTC into fiat currency
It-Bit	USD	581.88	0.37	0.1%
BITFINEX	USD	583.86	1.05	0.1%
BitStamp	USD	579.07	0.53	0.25%
OKCOIN	CNY	584.01	42.12	0.2%
Kraken	USD	585	0.71	0.1-0.26% taker fee

TABLE II
 A COMPARISON OF THE VARIOUS MAJOR BITCOIN EXCHANGES ON THE BASIS OF FEE STRUCTURE [7]

Exchange Platform	FEE RANGE		Bank Wire		Bank Transfer Time
	Maker fee	Taker fee	IN	OUT	
Bitfinex	0.0%-0.1%	0.1%-0.2%	0.1%	0.1%	2-4 business days
Coinbase	0%	0.25%	\$10	\$25	2-4 business days ¹
Bitstamp	Varies	0.1%-0.25%	0(national)	\$10 for amounts<\$1000 2% for amounts>\$1000 ²	2-5 business days
OkCoin	0%	0.1%-0.2%	0%	0.1%	3-5 business days
KRAKEN	0.0%- 0.16%	0.1%-0.26%	0.19%	0.19%	1-5 business days
BTC-e	0.2%	0.2%	\$20	varies	Doesn't accept bank transfers from US citizens or banks

¹ Coinbase offers the facility of instant exchange, where you can transfer either Bitcoins or the converted amount in USD by the use of their conversion service. Fees: 0.1% fixed. Debit card withdrawal fees. SEPA fees = 0.9€

“Trading platforms will include Bitfinex, Kraken, itBit, Coinbase, Bitstamp and Genesis Global. Trading will be providing pricing data, based upon which the reference prices will be calculated.” [6] This move, indicative of the progress being made with Bitcoins, will not only provide a credible reference to the users for Bitcoin’s price but also go a long way in reducing the volatility in the Bitcoin markets. With so many developments happening with the exchange platforms, it is beneficial for the reader to an idea about them and the various financial instruments related to Bitcoins so that they can shape their portfolio according to their own individual requirements. Tables I and II compare a few major Bitcoin exchanges.

The reader should pay attention to the fact that these exchanges charge fees according to the volume transacted by the user on the exchange. We will consider the example of Coinbase [32] to gain a better understanding.

➤ COINBASE [32]

- Provides Bitcoin Buying and Selling service to 18 countries, but only in Europe and USA
- Requires the client to link his Coinbase account with his bank account and Bitcoins are released only when the amount from the bank has been accredited into the Coinbase account. This takes up-to 3-5 working days.

Region	Method	Currency	Direction	Time	Fee
World Wide	Bitcoin	BTC	In/Out	Instant	Free†
USA	ACH	USD	In/Out	5 business days	Free
USA	Wire	USD	In/Out	1 business day	\$10/\$25
Canada	Interac	CAD	In	Instant	\$1
Canada	EFT	CAD	In/Out	4 business days	\$1
EU*	SEPA	EUR	In/Out	2 business days	Free
UK	Wire	GBP	In/Out	1 business day	£5/£30
Singapore	Xfers	SGD	In	Instant	Free
Singapore	Xfers	SGD	Out	Instant/3 day	\$\$2.99/Free

Fig. 3 The transaction volume based fee structure at Coinbase [31]

A. Bitcoin Trading Opportunities

Let’s take a look at some of the basic trading possibilities with Bitcoins and realise how far the financial world has progressed with Bitcoin as an asset class.

1. Leverage Trading (trading Bitcoins on margin): TeraExchange is credited to be the first exchange to offer Bitcoin based derivatives. Other Forex Brokers like BitMEX and others also now offer Bitcoin trading services on margin.
2. Savings Account Interest: Some exchanges (as shown in Table III) also offer facility of earning interest on deposits made by the traders. These funds can be used for Margin funding which is basically lending the deposited Bitcoins to other traders.
3. Bitcoin Options: There are two types of Bitcoin options available for trading- Vanilla options and Binary options. Deribit is the only major platform which provides the

facilities of both option and leverage (margin) trading.

4. ETFs [10]: As sophisticated instrument as ETFs are also available [2]. Currently a Bitcoin ETF is issued by Bitcoin Investment Trust, owned by Grayscale Investments, LLC. Bloomberg Ticker: XBTFUND [36].

SolidX Bitcoin Trust and Winklevoss Bitcoin Trust both have filed S-1 forms with the Securities and Exchange Commission. Thus, we can see that Bitcoin is not just a tech-geeks’ thing anymore. People have started realising the plethora of possibilities with this new asset class. Let’s dig deeper and see the different Bitcoin related financial instruments available.

Algorithmic Trading

The Algorithmic Bitcoin Trading Market is quite established and there are a lot of websites which allow to either use their bots or build your own bots and trading strategies using your own algorithms. Some examples include:

- **CryptoTrader** provides the users with the facilities of ready-made Bitcoin trading bots which can either be used for free or be bought. <https://tradewave.net/> [11] also offers similar features to users.
- **HassOnline** provides fully customizable bots with the ability to recognize a wide array of signals in the market and implement quite a few profitable strategies.

Arbitrage and Bitcoins

Fig. 5 has been taken from Bitcoinanalytics.com [21] and it shows the Bid-Ask Spreads for different Bitcoin Exchanges at the same point in time. Anyone, just by looking at the table, will be able tell that there are significant differences in prices across exchanges and hence, there should exist an arbitrage opportunity i.e. buy Bitcoins at the exchange where they are priced lower and then sell those Bitcoins at exchanges where their prices are higher and make money without any risk. Yes, there exist arbitrage opportunities, but the real question is: Are they profitable? There are quite a few factors need to be taken into consideration before we can comment on the profitability of such trades. These are:

- **Exchange Platform Fees:** In our discussion in the earlier section about the exchanges, we saw that the average transaction fee is around 0.2%, plus the bank fees. Then there is an issue of Orderbook, which basically is the fact that these transaction fees at exchanges vary according to the number of Bitcoins transacted as well.
- **Time:** Buying on an exchange, transferring the Bitcoins to the other exchange and selling Bitcoins on the exchange to which we have transferred them, can take up to 30 mins or more depending on the number of steps involved in the verification process [1]. Transferring fiat currency takes an even longer time. This is too long a time for you to hinge your money on this trade because by the time that the transaction gets confirmed, the exchange rates might change completely and you might just lose money instead of earning it.
- **Not enough people:** If the exchange does not have enough transaction volume, you might not be able to find

a buyer/seller at the price when there is a possible arbitrage opportunity.

- **High Capital Requirements:** Given that most of the spread will be taken up by the different transaction fees, to make a decent margin, the amount of capital that will need to be invested will be very high.

Let's take an example to make things more lucid. From Fig. 5, we see that bistamp (row 4) and lake (column 9) have a spread of 1.48%. So you will want to buy Bitcoins from bitstamp for \$576.8 and sell at lake for \$585.31. Now, let's look at the transaction fees of buying 1 Bitcoin. To buy the Bitcoin at bistamp you will have to pay 0.25% which is \$1.442. Then you will want to transfer those Bitcoins to lake, but confirmation of such transfers can take up to an hour. Assuming the arbitrage window is still open after you have received the Bitcoins on lake and also that you have been able to find a buyer of those Bitcoins at the exchange, which is not easy if the transaction volume on the exchange is low; then you will go for executing the transaction. The taker fees at Lake is 0.2% which amounts to \$1.17. This transaction will take time to get confirmed (one block of transactions in a blockchain takes about 10 minutes [1]). And then withdrawing the remaining $(585.31 - 1.17) = \$584.14$, you will have to pay a

withdrawal fees of $(0.3\% + \$5) = \6.75 . This does not include the bank fees yet. Already you have paid \$9.364 $(1.442 + 1.17 + 6.75)$ and lost money (the arbitrage opportunity was $\$585.31 - \$576.8 = \$8.51$) and that is without the bank fees. Thus the arbitrage opportunity which looked extremely lucrative is not actually profitable. Thus, there are a lot of barriers to arbitrage trading in Bitcoins and this makes it extremely difficult for an average investor to make money because of the pricing difference. And even if there are a few instances of arbitrage that are created they are closed down on by the numerous algorithmic trading platforms for Bitcoins [11]

III. PORTFOLIO ANALYSIS

This section analyses whether adding Bitcoin to a portfolio with equity and other assets classes gives a better risk-adjusted return or not i.e. analyses the effect of addition of Bitcoins by comparing the Sharpe ratio for the different portfolios with and without Bitcoins. Then, we also see what the optimal portfolio is (maximizing the Sharpe ratio). We have considered the following asset classes shown in Table IV.

TABLE III
 COMPARATIVE STUDY OF THE FINANCIAL INSTRUMENTS OFFERED BY THE DIFFERENT EXCHANGE PLATFORMS

Broker	Leverage trading			Options		Savings account (margin funding)	
	Instruments	Max Leverage	Initial Margin	Maintenance Margin	VANILLA		BINARY
BitMex	Futures/Swaps	100:1	1%	0.5%		X	X
Bitfinex	CFDs	3.33:1	30%	15%		X	✓
OKCoin	Futures	20:1	5%	1%		X	✓
Deribit	Forwards	20:1	5%	3%	✓		X
BTC.sx (MAGNR)	CFDs	10:1	5 USD	***		X	✓
CryptoFacilities	Futures/Turbo Futures	50:1	2%	1.75%		X	X
SimpleFX	CFDs/derivatives	500:1	variable	30%		X	X
Quoine	Futures	25:1	30%	20%		X	✓
Satoshi option			X		X		✓
Anyoption			X		X		✓
Setoption			X		X		✓
Bloombex options			X		X		✓
Coinut			X			✓	✓



Fig. 4 Snapshot of a trading bot at HassOnline [20]

10	allUSD											
allUSD	2.16% (123.64)											
10	bitbayUSD	bitfinexUSD	bitkonanUSD	bitstampUSD	btceUSD	coinbaseUSD	hitbtcUSD	krakenUSD	lakeUSD	okcoinUSD	rockUSD	vccUSD
bitbayUSD	-67.7% (-5842.66)	-32.61% (-2814.6)	-63.23% (-5456.83)	-33.25% (-2869.63)	-33.08% (-2854.61)	-32.76% (-2826.91)	-34% (-2934.15)	-32.87% (-2836.82)	-32.18% (-2776.9)	-32.95% (-2843.56)	-33.54% (-2894.87)	-93.43% (-8063.42)
bitfinexUSD	-52.1% (-3032.2)	-0.07% (-4.14)	-45.47% (-2646.37)	-1.02% (-59.17)	-0.76% (-44.15)	-0.28% (-16.45)	-2.13% (-123.69)	-0.45% (-26.36)	0.58% (33.56)	-0.57% (-33.1)	-1.45% (-84.41)	-90.26% (-5252.96)
bitkonanUSD	-55.31% (-3449.79)	-6.76% (-421.73)	-49.12% (-3063.96)	-7.64% (-476.76)	-7.4% (-461.74)	-6.96% (-434.04)	-8.68% (-541.28)	-7.12% (-443.95)	-6.16% (-384.03)	-7.23% (-450.69)	-8.05% (-502)	-90.92% (-5670.55)
bitstampUSD	-51.68% (-2980.66)	0.82% (47.4)	-44.99% (-2594.83)	-0.13% (-7.63)	0.13% (7.39)	0.61% (35.09)	-1.25% (-72.15)	0.44% (25.18)	1.48% (85.1)	0.32% (18.44)	-0.57% (-32.87)	-90.18% (-5201.42)
btceUSD	-51.8% (-2994.93)	0.57% (33.13)	-45.12% (-2609.1)	-0.38% (-21.9)	-0.12% (-6.88)	0.36% (20.82)	-1.49% (-86.42)	0.19% (10.91)	1.22% (70.83)	0.07% (4.17)	-0.82% (-47.14)	-90.2% (-5215.69)
coinbaseUSD	-52.01% (-3020.96)	0.12% (7.1)	-45.37% (-2635.13)	-0.83% (-47.93)	-0.57% (-32.91)	-0.29% (-5.21)	-1.94% (-112.45)	-0.26% (-15.12)	0.77% (44.8)	-0.38% (-21.86)	-1.26% (-73.17)	-90.25% (-5241.72)
hitbtcUSD	-53.41% (-3195.77)	-2.8% (-167.71)	-46.96% (-2809.94)	-3.72% (-222.74)	-3.47% (-207.72)	-3.01% (-180.02)	-4.8% (-287.26)	-3.17% (-189.93)	-2.17% (-130.01)	-3.29% (-196.67)	-4.14% (-247.98)	-90.53% (-5416.53)
krakenUSD	-52.11% (-3033.01)	-0.09% (-4.95)	-45.48% (-2647.18)	-1.03% (-59.98)	-0.77% (-44.96)	-0.3% (-17.26)	-2.14% (-124.5)	-0.47% (-27.17)	0.56% (32.75)	-0.58% (-33.91)	-1.46% (-85.22)	-90.27% (-5253.77)
lakeUSD	-52.43% (-3072.21)	-0.75% (-44.15)	-45.85% (-2686.38)	-1.69% (-99.18)	-1.44% (-84.16)	-0.96% (-56.46)	-2.79% (-163.7)	-1.13% (-66.37)	-0.11% (-6.45)	-1.25% (-73.11)	-2.12% (-124.42)	-90.33% (-5292.97)
okcoinUSD	-51.92% (-3010.26)	0.31% (17.8)	-45.27% (-2624.43)	-0.64% (-37.23)	-0.38% (-22.21)	0.09% (5.49)	-1.76% (-101.75)	-0.08% (-4.42)	0.96% (55.5)	-0.19% (-11.16)	-1.08% (-62.47)	-90.23% (-5231.02)
rockUSD	-77.12% (-9397.55)	-52.27% (-6369.49)	-73.96% (-9011.72)	-52.73% (-6424.52)	-52.6% (-6409.5)	-52.37% (-6381.8)	-53.25% (-6489.04)	-52.46% (-6391.71)	-51.96% (-6331.79)	-52.51% (-6398.45)	-52.93% (-6449.76)	-95.35% (-11618.31)

Fig. 5 The bid ask spreads for various Bitcoin exchanges [21]

TABLE IV
THE ASSET CLASSES CONSIDERED AND THE CORRELATION OF DAILY RETURNS WITH BITCOIN'S DAILY RETURNS

SNo	ASSET CLASS	Correlation with Bitcoin
1.	S&P500	0.0331
2.	Barclays Bond Index	0.328123
3.	Oil (WTI Cushing Crude Oil Spot Index)	0.057977
4.	Real Estate (MSCI World Real Estate Investment Trust)	0.240114
5.	Gold (USD Price)	0.001694
6.	MXEF (MSCI Emerging World Index)	0.006433
7.	Baltic Dry Index	-0.00394

The low correlation of Bitcoin with any other major asset class is an indication of it being able to diversify a portfolio and thus reducing the risk.

The aim of this section is to try and replicate the portfolios of international investors holding a wide array of asset classes and then check the results of adding Bitcoins via back-testing on the daily returns data. The reader should note, that we have assumed that the investor buys and sells all the asset classes (including Bitcoin) daily i.e. the holding period is just 1 day.

There have been quite a few research papers published relating to Bitcoins (around 650), but all of them have, generally, dealt with the legalities and technical details associated with Bitcoin. Just one paper, "Virtual Currency, Tangible Return: Portfolio Diversification with Bitcoins by Marie Brière, Kim Oosterlinck, Ariane Szafarz, September 2013" [37] talks about the results of having Bitcoins in your portfolio. They took the data available till 2013 and plotted the mean variance efficient frontier to compare the Returns Vs the Volatility of the portfolios for different degrees of risk-averseness. We have taken a wider array of asset classes for a longer period and used the concept of risk-adjusted return of the daily returns (calculated through the geometric mean) for every portfolio to highlight the consequences of adding Bitcoin to them.

As observed in Fig. 6, returns from Bitcoin are quite intriguing with a high volatility but also a high mean return. This is a powerful observation and can be taken advantage of in a portfolio especially with as low correlations as Bitcoin has with major asset classes.

The portfolios shown in Table V were considered.

DESCRIPTIVE STATISTICS	Return S&p 500	Return BTC	Return Barclays Capital	Return oil	Return Real estate	Return gold	Return MXEF	Return baltic
SKEWNESS	-0.458	-0.373	-37.319	-14.420	-0.274	-0.565	-0.332	-3.080
KURTOSIS	4.23	27.39	1411.61	403.09	5.50	5.38	2.65	60.49
MEDIAN	0.000601	0.000473	0.000178	-0.000197	0.000662	0.000166	0.000379	-0.001429
STDEV	0.97%	8.01%	2.19%	3.18%	0.96%	1.08%	1.03%	2.56%
MEAN	0.048%	0.695%	-0.053%	-0.087%	0.038%	0.012%	-0.003%	-0.0577%

Fig. 6 The descriptive statistics of the daily returns of the various assets in our portfolios

TABLE V
 THE DIFFERENT PORTFOLIOS CONSIDERED WITH THE AIM TO COVER ALL THE MAJOR ASSET CLASSES THAT COULD BE HELD BY AN AVERAGE INTERNATIONAL INVESTOR

Portfolio	Constituent Asset Classes	Weight of each asset class
A	S&P500 + Bitcoin (BTC)	1/2
B	S&P500 + Bitcoin (BTC) + Barclays Bond Index	1/3
C	S&P500 + Bitcoin (BTC) + Barclays Bond Index+ Oil	1/4
D	S&P500 + Bitcoin (BTC) + Barclays Bond Index+ Oil + Real Estate	1/5
E	S&P500 + Bitcoin (BTC) + Barclays Bond Index+ Oil + Real Estate + Gold	1/6
F	S&P500 + Bitcoin (BTC) + Barclays Bond Index+ Oil + Real Estate + Gold+ MXEF	1/7
G	S&P500 + Bitcoin (BTC) + Barclays Bond Index+ Oil + Real Estate + Gold+ MXEF+ Baltic Dry Index	1/8

PORTFOLIO	A		B		C		D		E		F		G	
	Without BTC	With	Without BTC	With	Without BTC	With	Without BTC	With	Without BTC	With	Without BTC	With	Without BTC	With
GEOMEAN	0.0456%	0.2583%	-0.0091%	0.2143%	-0.0479%	0.1290%	-0.0209%	0.1221%	-0.0111%	0.1085%	-0.0084%	0.0969%	-0.0194%	0.0626%
STDEV	0.975%	4.342%	1.160%	2.995%	1.702%	2.661%	1.360%	2.177%	1.134%	1.829%	1.012%	1.599%	0.947%	1.444%
SHARPE RATIO	0.0468	0.0595	-0.0079	0.0716	-0.0281	0.0485	-0.0154	0.0561	-0.0098	0.0593	-0.0083	0.0606	-0.0204	0.0434

Fig. 7 The comparative study of the geometric means of the daily returns of the portfolios (for the last 6 years) with and without Bitcoins, the standard deviations of the respective portfolios and the Sharpe ratios

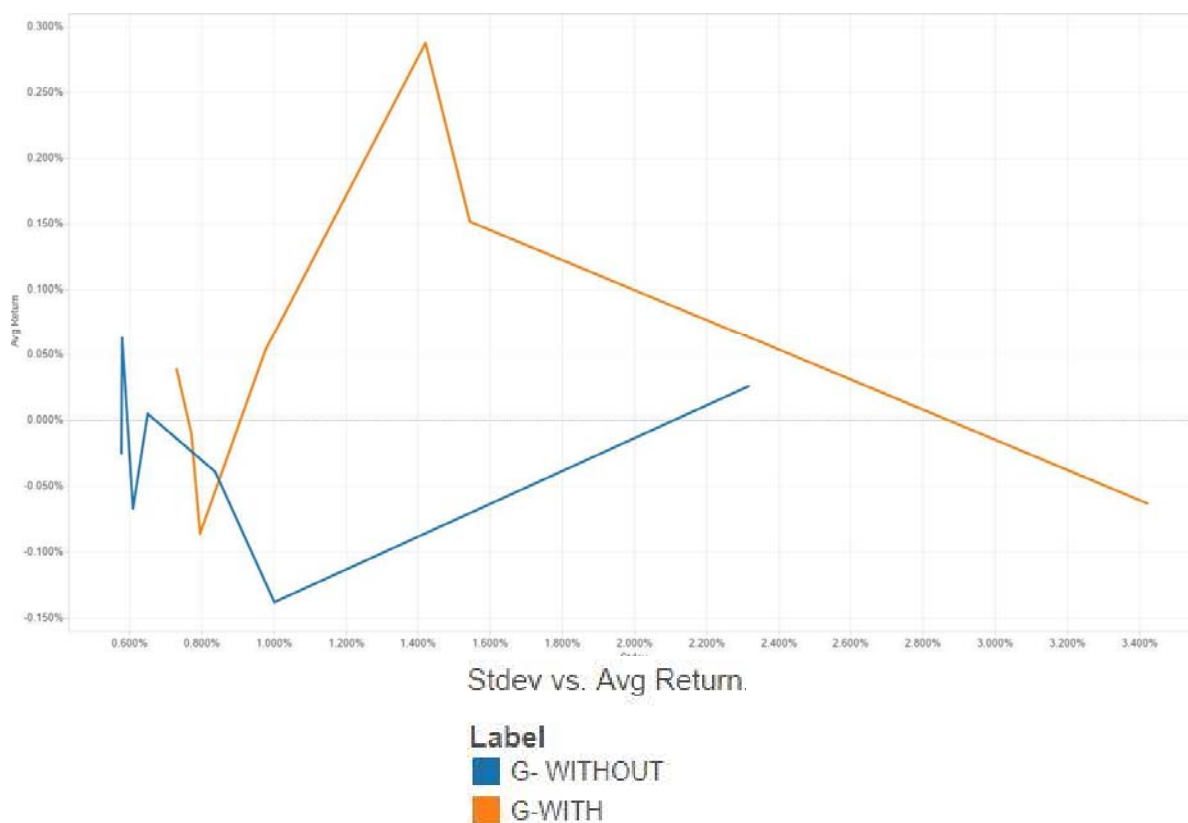


Fig. 8 The Average returns Vs the Standard Deviation for the portfolio G

From Fig. 7, it can be easily seen that added Bitcoin to portfolio is definitely advantageous, despite the increase in volatility, because it gives you a better Sharpe ratio in every portfolio considered, with the highest of .0716 being achieved in the portfolio B i.e. equally weighted [S&P500 + Bitcoin (BTC) + Barclays Bond Index]. We will now move on to constructing optimal portfolios i.e. portfolios with the highest

Sharpe ratio in various cases to showcase the value of having this new asset class in your portfolio

Fig. 8 shows the average returns for Portfolio G against the standard deviation for two cases: With Bitcoin (Orange) and without Bitcoin (Blue). It is easily seen that for almost every standard deviation which is a measure of volatility/risk, the portfolio with Bitcoin has higher returns and thus a higher Sharpe Ratio.

After having seen the financial advantage of having Bitcoins in your portfolio, we will analyze the proportion of our portfolio that we should allocate to Bitcoin by constructing Optimal Portfolios (Highest Sharpe Ratio)

Optimal Portfolio Construction

To construct the optimal portfolio, we calculate the standard deviation, the mean and hence the Sharpe ratio for the equally-weighted portfolio. Then using Solver in Excel, we maximize the Sharpe ratio for three cases-

1. No Short selling
2. Unconstrained Short selling is allowed
3. Minimum holding constraint with no short selling

In other columns of Fig. 9, we have the mean and standard deviations of the returns on the various assets classes considered.

INDIVIDUAL ASSETS		
Asset	mean	stdev
BTC	0.69%	8.01%
S&P500	0.05%	0.97%
GOLD	0.01%	1.08%
REAL ESTATE	0.04%	0.96%
BARCLAYS BOND	-0.05%	2.19%
MXEF	0.00%	1.03%
OIL	-0.09%	3.18%
BALTIC	-0.06%	2.56%

Fig. 9 The mean and standard deviation of the individual assets

COVARIANCE-VARIANCE MATRIX								
	Return S&p 500	Return BTC	Return Barclays Capital	Return oil	Return Real estate	Return gold	Return MXEF	Return baltic
Return S&p 500	0.0094%	0.0026%	-0.0008%	0.0078%	0.0073%	0.0000%	0.0049%	-0.0004%
Return BTC	0.0026%	0.6428%	0.0577%	0.0611%	0.0045%	0.0001%	0.0005%	-0.0008%
Return Barclays Capital	-0.0008%	0.0577%	0.0481%	0.0497%	-0.0004%	0.0011%	0.0000%	-0.0009%
Return oil	0.0078%	0.0611%	0.0497%	0.1009%	0.0056%	0.0048%	0.0073%	0.0008%
Return Real estate	0.0073%	0.0045%	-0.0004%	0.0056%	0.0092%	0.0011%	0.0054%	-0.0010%
Return gold	0.0000%	0.0001%	0.0011%	0.0048%	0.0011%	0.0118%	0.0010%	-0.0008%
Return MXEF	0.0049%	0.0005%	0.0000%	0.0073%	0.0054%	0.0010%	0.0105%	-0.0005%
Return Bultic	-0.00038%	-0.00081%	-0.00087%	0.00083%	-0.00103%	-0.00077%	-0.00046%	0.000655305

Fig. 10 The Variance-Covariance matrix of the returns of the individual assets

Asset	weight	mean	stdev
BTC	0.125	0.69%	8.01%
S&P500	0.125	0.05%	0.97%
GOLD	0.125	0.01%	1.08%
REAL ESTATE	0.125	0.04%	0.96%
BARCLAYS BOND	0.125	-0.05%	2.19%
MXEF	0.125	0.00%	1.03%
OIL	0.125	-0.09%	3.18%
BALTIC	0.125	-0.06%	2.56%
TOTAL WEIGHTS	1.000		
PF STDEV	1.4%		
pf mean	0.074%		
sharpe	0.0514		

Fig. 11 The different asset classes considered along with the mean and standard deviation of their daily returns from 2nd July, 2010 to 2nd August, 2016

A very powerful result that comes from looking at Figs. 13 and 14 is that solver, while creating optimal portfolios (maximum Sharpe ratio), is allocating the maximum possible proportion of the portfolio to Bitcoins which speaks to its low correlation with other assets and the higher risk adjusted return obtained from adding it to the portfolio of an international investor. This implies that the high volatility of Bitcoin is

offset by its high returns and given its low correlation (Table IV) with other major asset classes, adding it a portfolio gives a better risk adjusted return.³

Asset	weight	mean	stdev
BTC	0.300	0.69%	8.01%
S&P500	0.100	0.05%	0.97%
GOLD	0.100	0.01%	1.08%
REAL ESTA	0.100	0.04%	0.96%
BARCLAYS	0.100	-0.05%	2.19%
MXEF	0.100	0.00%	1.03%
OIL	0.100	-0.09%	3.18%
BALTIC	0.100	-0.06%	2.56%
TOTAL WE	1.000		
PF STDEV	1.2%		
pf mean	0.198%		
sharpe	0.1622		

Fig. 12 The optimal portfolio with a minimum holding constraint of 10%

³ The reader should keep in mind that these results are bases on the assumption that the investor buys and sells these assets daily, from 2nd July, 2010 to 2nd August, 2016

The reader should also note that the optimal portfolios have been calculated assuming that unconstrained long and short selling are possible.

Asset	weight	mean	stdev
BTC	0.980	0.69%	8.01%
S&P500	0.000	0.05%	0.97%
GOLD	0.020	0.01%	1.08%
REAL ESTATE	0.000	0.04%	0.96%
BARCLAYS BOND	0.000	-0.05%	2.19%
MXEF	0.000	0.00%	1.03%
OIL	0.000	-0.09%	3.18%
BALTIC	0.000	-0.06%	2.56%
TOTAL WEIGHTS	1.000		
PF STDEV	1.0%		
pf mean	0.681%		
sharpe	0.7160		

Fig. 13 The optimal portfolio without short selling and no minimum holding constraint

Asset	WEIGHT	STDEV	mean
BTC	3.456	8.01%	0.69%
S&P500	0.003	0.97%	0.05%
GOLD	0.310	1.08%	0.01%
REAL ESTATE	-0.272	0.96%	0.04%
BARCLAYS BOND	-2.563	2.19%	-0.05%
MXEF	0.339	1.03%	0.00%
OIL	-0.249	3.18%	-0.09%
BALTIC	-0.023	2.56%	-0.06%
TOTAL WEIGHTS	1.000		
PF STDEV	1.9%		
pf mean	2.552%		
sharpe	1.317		

Fig. 14 The optimal portfolio with unconstrained short selling



Fig. 15 The Market capitalization of Bitcoin [22]

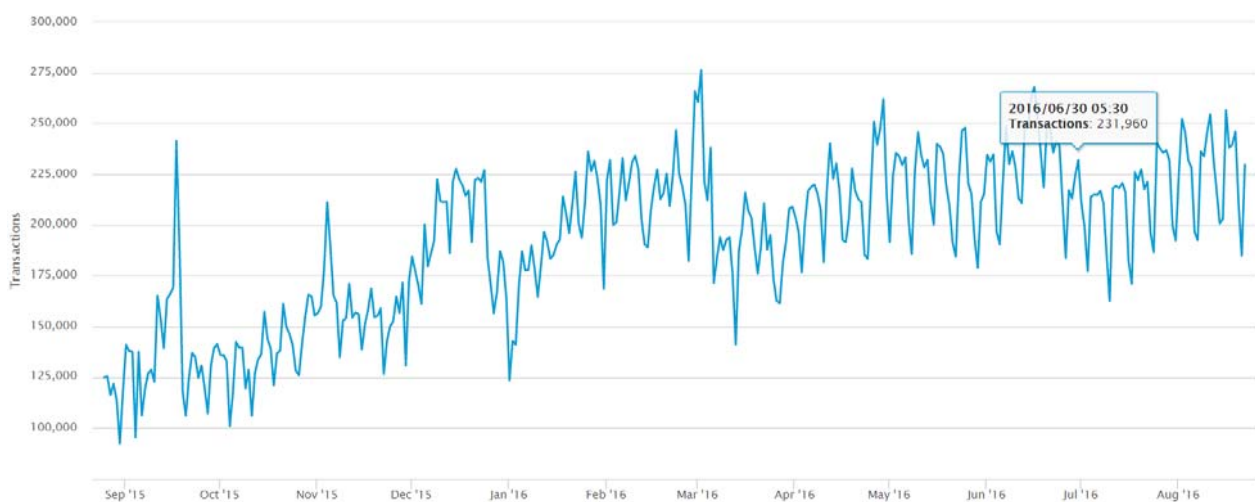


Fig. 16 The number of confirmed Bitcoin transactions per day [22]



Fig. 17 The Volatility in the Bitcoin price [22]

Bitcoin Legality - Map of Regulatory Landscape

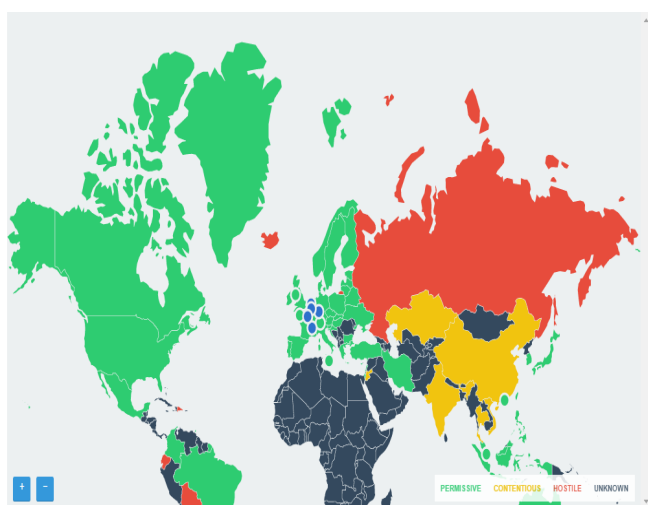


Fig. 18 The acceptance of Bitcoin; Country-wise [23], [24]: Green- High acceptance, Yellow- Progressive, Red- Illegal

IV. ACCEPTANCE

Despite Bitcoin being a revolutionary currency and providing features unlike any other financial instrument and giving you a higher risk adjusted return as seen in Section III, it is still a relatively new asset class does not make sense for an investor to add Bitcoins to his portfolio until he has a decent idea about the acceptance of Bitcoin as a medium of exchange. This section discusses the acceptance of Bitcoins at 3 different fronts- by Countries, by Banks and by Merchants.

As can be seen from Fig. 15, Bitcoin had a growing market capitalization. Fig 16 depicts the increasing confirmed transactions per day (Current Average: 231,960 transaction per day) and a continuously stabilizing volatility in the price level is seen in Fig 17. The current volatility of Bitcoin according to the Bitcoin Volatility Index is 2.28% (as on 29th August 2016) [Fig. 17]. Thus, it appears as if the general outlook towards Bitcoin, currently, is positive. Let us explore the acceptance of Bitcoins across the different fronts that we discussed earlier, Countries, Banks, and Merchants.

A. Country Acceptance

This section compares the outlook of different countries and their governments towards Bitcoin including the taxation policies by the central banks.

TABLE VI
 COMPARATIVE ANALYSIS OF THE ACCEPTANCE LEVEL OF BITCOIN BY DIFFERENT COUNTRIES

Country	Acceptance	Outlook towards Bitcoin
USA [23]	High	IRS considers Bitcoin as a property and hence there is a Capital Gains Tax imposed on Bitcoin transactions. But in general, a positive outlook and the acceptance of Bitcoin as a currency is high.
UK [23]	High	Bitcoin is considered as "Private Money" and the profit and losses on the transactions are subject to Capital Gains Tax. No VAT on Bitcoin itself in transactions.
Germany [23]	High	Bitcoin is recognized as "Private Money". But in June 2013, all the Bitcoin transactions in Germany were exempted from Capital gains Tax indicating an accepting attitude towards the digital currency
Canada [23]	High	Bitcoins come under the various taxation policies of the government. [13]
Denmark [23]	High	The Danish Tax Board doesn't charge Capital Gains Tax on Bitcoin Trading. Positive Outlook.
Australia [23]	High	The government removed the double taxation of GST on Bitcoin transactions in a move indicating a positive outlook. Companies in Australia are allowed to trade in Bitcoins.
EU [23]	High	A big boost to the Bitcoin economy occurred when the European Court of Justice ruled not to charge VAT on Bitcoin transactions as it is to be treated like "Money"
China [23]	Medium	Banking institutions and employees are banned from engaging in Bitcoin transactions, but common citizens can both trade and mine Bitcoins.
India [23]	Medium	The RBI has no plans to regulate to Bitcoins, as of now, but had cautioned the users about virtual Currencies including Bitcoin.
Japan [23]	Medium	Individuals allowed, but banks and institutions not allowed to transact with Bitcoins. Consumption tax on Bitcoin transactions.
Bangladesh [23]	Illegal	Usage of Bitcoins is banned. If caught transacting in Bitcoins, it can lead to incarceration under the country's anti-money laundering laws.
Russia [23]	Illegal	"Ministry of Finance calls it a 'money surrogate' which is illegal"

Fig. 18 gives the acceptance level of Bitcoins all across the world. The color scheme is given in the description. Then, we move onto the comparison of the different taxation policies in

Table VI and an in-depth look at the acceptance level in different countries.

1. Russia

It is called as “Surrogate Currency” by the Ministry Of Finance and it is illegal to mine or issue Bitcoins. But it will consider Bitcoin as a foreign currency or tax purposes and will allow foreign trading of virtual currency [19].

2. Spain

The country has exempted Bitcoin transactions from VAT, unlike USA where IRS has said Bitcoins transactions will be taxed.

3. China

Times have definitely changed from when earlier the country banned crypto-currencies which led to a more than 20% fall in regulatory sort of framework, which, according to the policy makers, will help trace the citizens’ stolen Bitcoins. Banks and financial institutions are still banned from dealing in Bitcoins, but over 90% of daily trading volume in Bitcoin is processed in Chinese Yuan as shown in Fig. 19

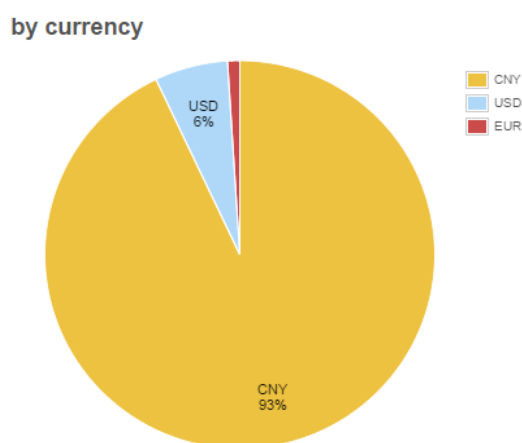


Fig. 19 Bitcoin Market share of currencies [25], [5]

4. Brazil and Venezuela

According to BitPay, a global Bitcoin payment processor, there has been an unbelievable increase of 1747% in Bitcoin transactions in Latin America in 2015 as compared to 2014 [29]. This has been attributed to various factors: A large proportion of the population is unbanked. For instance according to a report by World Bank [35], about 50% in Brazil i.e. nearly 210 million people are still unbanked. But now they just need a mobile phone to transact all across the globe. The high inflation rate and the unstable economies: IMF expects inflation in Venezuela to be at 480% [12] by the end of 2016 and at unsustainable high levels of 1640% in 2017. With this unstable economy, there is a constantly growing black market for dollar in Latin America. One report stated that there has been a decrease in the value of the Bolivar by an astonishing 82% during the last year, with 1000 bolivars being exchanged for 1 dollar in the black markets. In Brazil, the transaction volumes surged to an all time high in Jan 2016 and the Brazilian market, according to reports [14]-[18] will

reach \$300m in 2016.

5. United Kingdom

It is now possible to buy almost any commodity or good through services like “giftoff [26]” which provides users with the ability to purchase gift cards from stores like Amazon, Apple using Bitcoins and other Crypto-currencies.

6. Afghanistan & The Caribbean

According to the World Bank 2015 Global Findex Report [36], nearly 50% of the Caribbean population is unbanked. The KYC process is extremely painstaking and it can take up to 90 days to just open an account. In Afghanistan, similar difficulties are faced in payment processing. With only Western Union operating there, it charges very high fees. But now, with the availability of Bitcoins and Mobile wallets, the payment processes are a lot faster, have lower transaction costs and are also a lot more reliable.

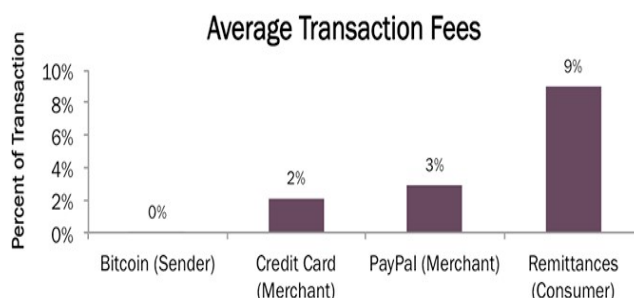


Fig. 20 Comparison of the transaction fees with and without using Bitcoin [33]

Estonia, the country known for its tech friendly government, hosts a number of Bitcoin ATMs and startups like Paxful – a platform which allows instantaneous exchange of Bitcoins. Australia removed the ‘double taxation policy on Bitcoin. The Danish Central Bank, Denmark, declared Bitcoin as NOT a currency and stated that it will not be regulating Bitcoin. South Korea has been a host to a lot of Bitcoin conferences. Vancouver, Canada, alone has 20 Bitcoin ATMs and is a home to a lot of Bitcoin startups. As evident from the discussion above, the general outlook of the world towards Bitcoin is becoming positive by the day.

7. Places To Spend Bitcoins

There are many websites [27], [28], ranging from travel to grocery products that offer information regarding places where Bitcoins are accepted

B. Banks

1. **WB21**, with over 650,000 customers spread across 180 countries, became the first major global digital bank to start accepting Bitcoin.
2. **Société Générale** has been looking to hire a Bitcoin/crypto currency developer
3. The agreement struck between **Sofort Banking**, and **247Exchange.com** will provide access to over 22,000 banks across Europe for purchasing Bitcoin. Sofort Banking group is “a merchant/banking conglomerate out

of Munich, Germany which represents over 30,000 merchants and hundreds of banks throughout Europe” [39].

4. **CITI group** is developing "CitiCoin" for transfers across countries. CITI group is also involved with Safaricom, the largest Mobile network operator in Kenya where about 50% of the population is unbanked, and now anyone with a mobile phone can process payments.
5. **Goldman Sachs** in [37] "The Future of Finance: Redefining the Way We Pay in the Next Decade" said that, "Bitcoin is a megatrend that could reshape the future of finance."
6. **PrivatBank**, one of Ukraine's largest banks announced the development of a Bitcoin-based solution for merchant payment services that would allow online businesses to accept Bitcoin with ease.
7. **Barclays** has been involved with a Bitcoin bank "Circle". Barclays provides the infrastructure needed by Circle to transfer money from any bank account in the UK, and thus, is about to become the first major international bank to have support transaction in Bitcoin. Barclays has also partnered with a Bitcoin Exchange which will allow people to make donations to it in Bitcoin, which is a step under its venture to try out Bitcoin as a currency.
8. **BNP Paribas** has been looking into adding Bitcoin to one of its currency funds.
9. **Credit Suisse** in [38], "Bitcoins-Money without Physical Form", took a lukewarm position towards Bitcoins.
10. **German Fidor Bank**, known for being more acceptable towards new technologies in the financial system, has been openly embracing Bitcoin.
11. **The central bank of Barbados** is actually considering holding a certain amount of Bitcoin as part of its portfolio of foreign reserves.

C. Merchants

Till now we have seen the reactions of a lot of countries and Banks towards Bitcoin, but what matters the most is the willingness of people to accept Bitcoin as a currency which is reflected in the willingness of merchants to accept Bitcoins in exchange for goods. So, are the merchants accepting Bitcoins? And are there any additional incentives for them to accept Bitcoins despite it being relatively new asset class and still being a bit more volatile than the traditional mediums of exchange like the fiat currencies or gold?

Besides the already discussed maturing phase that the currency is in, the major incentives for merchants and vendors are the lower transaction fees and instant money transfer process. You can transfer thousands of dollars in a matter of seconds and at a much lower transaction fee.

Now let's look at a few merchants which have embraced Bitcoin-

1. **Bitit** is a Paris based Bitcoin platform, which allows users to get Bitcoins in exchange for cash or by using their credit cards both in stores and online.
2. **Wordpress** was the first major firm to accept Bitcoins in 2012.

3. Tech giants like **Microsoft, TigerDirect Newegg** and **Dell** embracing Bitcoins as a payment method
4. **LOT Polish airlines**
5. **Coinay**, a service which allows people to spend cash for Bitcoins, is available in 3,000 Spanish stores.
6. **Coinbase**, the Bitcoin payment processor, claims to have developed the first Bitcoin debit card, "Shift Card". This is a Visa Debit card allowing users to purchase stuff online and offline at more than 38 million merchants worldwide.
7. A large number of **Las Vegas Casinos**.
8. The auto industry giants- **Lamborghini and McLaren**.
9. **Indomaret** with over 10,000 convenience stores spread across Indonesia also has started accepting Bitcoins.
10. Precious Metal dealer **JM Bullion**, gaming Platform **Steam, MercadoLibre** the eBay of Latin America).
11. Gift cards at Amazon, Starbucks, XBOX and iTunes.

This is a continuously growing list and reflects the increasing acceptance of merchants and people, as a whole, towards Bitcoins as a medium of exchange.

V. CONCLUSION

In this paper, we started by introducing Bitcoin and discussed the basic technicalities associated with it. As we moved on to Section II, we saw that with the continuously growing number of financial derivatives and exchange platforms dealing with Bitcoins, the progress being made on Bitcoin in the financial industry is staggering and it is not unreasonable to conclude that the currency is past its nascent stage. The major focus of this paper was analyzing the effect of adding Bitcoins to your portfolio and as we saw in Section III, they give a better risk adjusted return portfolio, which should be persuasive enough for people to start considering Bitcoins as a new asset class. Based on the discussion in Section IV, we can conclude that the global outlook towards Bitcoin has been shaping into a more positive one by the day, with countries both developing and developed, major banks and a continuously increasing number of merchants embracing this technology

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