

The Future of Cryptocurrency

An Investor's Comparison of Bitcoin and Ethereum

Abstract

Bitcoin and Ethereum are two highly disruptive cryptocurrencies looking to leverage blockchain technologies to drive innovation across numerous industries. The objective was to analyze each cryptocurrency to develop the ideal investment strategy for a \$1,000,000 investment which must be held for five years without any additional trading.

To develop an ideal investment strategy, we analyzed both currencies. After looking at the qualitative similarities and differences between each currency, we analyzed the historical performances of each and extrapolated these values to form a five-year projection. Conversations with industry professionals helped to identify the most probable and impactful factors for the future demand of both currencies. After incorporating our results and accounting for variance, we ran simulations to predict the expected values given a range of inputs and factors.

After weighing these findings, the appropriate investment ratio proved to be 69:31 for Bitcoin and Ethereum respectively. Bitcoin offered a higher expected value, but the volatility and speculative nature of cryptocurrencies indicated a need for diversification across platforms.

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What is Money Anyway?

Since societies transitioned from a barter economy to using a money as a medium of exchange, individuals have tried to devise systems that allow for rational ways to exchange value. In order to help make goods and services commensurable the Greek philosopher Aristotle came up with four criteria that help to dictate what is considered to be ‘good money’ (Lee, 2009):

1. It must be **durable**
2. It must be **portable**
3. It must be **divisible**
4. It must have **intrinsic value**

Originally the preferred medium of exchange was gold as it was able to fulfill all four of these criteria. As economies grew and the demand for a medium of exchange increased, governments were forced to create a more accessible medium of exchange that they could control and regulate. This was the birth of fiat currency. This particular medium of exchange has been adopted worldwide, however it has come with its own set of issues.

In order to help fix some of these issues, cryptocurrencies began to emerge in 2009, leveraging a disruptive technology called blockchain. A cryptocurrency is a digital currency that uses cryptography for security (Investopedia, 2016). Blockchain specifically deals with the way in which data is structured and allows for the existence of decentralized digital ledgers where single organizations are not able to effect transactions (Hackett, 2016). Currently the two most widely adopted cryptocurrencies are Bitcoin and Ether, the currency that is used to power the Ethereum blockchain.

The Investment

With the recent rise in popularity of cryptocurrencies many investors are now trying to determine how to invest into this new asset class. As with any investment into a new technology there are many factors to consider when assessing their future. In order to make an informed decision one must look at the origins of the technology as well as the potential applications and limitations in the foreseeable future.

This paper aims to evaluate what the price (in USD) of Bitcoin (BTC) and Ether (ETH) will be in the next 5 years using thorough quantitative and qualitative analysis. From this evaluation a decision will be made on an appropriate investment allocation between the two currencies for this crypto-portfolio.

The Contenders



Bitcoin is the most widely known and used cryptocurrency in the world. The current market capitalization of just over **\$10 billion** (USD) (Crypto-Currency Market Capitalizations, 2016).


Bitcoin was originally developed by Satoshi Nakamoto as a strictly peer-to-peer electronic payment system and a solution to the problem of double-spending (Nakamoto, 2008). It is primarily designed to eliminate the need of financial institutions or ‘trusted third-party’ entities.

Bitcoin does this by eliminating the possibility of fraud, increasing efficiencies, and providing objective proof-of-work to guarantee validity and security in any transaction (Nakamoto, 2008).

The use of a public ledger as well as digital signatures allow for a secure and anonymous transaction without the need for trust, as the public network of nodes validates transactions through finding a consensus among a majority of nodes. Thus far, the primary use cases for

Bitcoin revolve around increasing efficiencies and eliminating unnecessary time and costs that

arrive from using multiple trusted third parties to facilitate transactions (Tapscott, 2016). Bitcoin is highly adoptable in markets that are lacking in traditional financial infrastructure but have access to mobile data, as well as markets with highly inflated currencies that require tools to allow for the mobilization and exchange of currencies (Magee, 2015). Bitcoin's multiversion concurrency control is unique and allows for safe concurrent transactions without significant delay (Greenspan, 2015).

The Ethereum logo, which is a stylized diamond shape with a dark grey center and a lighter grey outer ring, is positioned to the left of the text.

Ethereum's main point of differentiation is the ability to leverage the application of 'smart contracts' within its code. While growing at a much more significant rate over the past year, Ethereum has a total market capitalization of only approximately **10%** of Bitcoin (Cryptocurrency Market Capitalizations, 2016). While the underlying currency, Ether, appreciates and depreciates in value, Ethereum's value is largely driven by its increased utility and ability to eventually eliminate third parties' involvement in determining contractual obligations. The main benefit of Ethereum can be found in the belief that, as long as it can be coded properly, Ethereum's smart contracts carry potentially unlimited utility (although, highly complex contracts could prove to be illogical at this point in time) (Greenspan, 2016). The Ethereum Network serves to facilitate the exchange of data, information, votes, etc. indicating that there is the possibility for use cases well beyond simply serving as a disruptor to the current financial institutions. The Ether currency serves as the 'gas' that powers the transactions within the Ethereum Network. Ethereum leverages a Turing-Complete language which could, in theory, solve any computational problem (DeRose, 2016), allowing for an even greater possibility for utility across many areas.

Both Ether and Bitcoin are mined by solving highly complex computational problems. Additionally, as more blocks are mined, the difficulty of finding new blocks increases in both cases.

Comparison: Where Bitcoin currently has a clearly defined use case in which disruption is possible, the possibilities for Ethereum to enter the market are far less distinct. Ethereum benefits from the possibility of much greater eventual impact. Bitcoin is currently better positioned to leverage and be incorporated into innovations that occur across many industries, whereas Ethereum is trying to drive the innovations. Ethereum is at a greater risk of experiencing disruption, as their network is the major driver of value (while the Ether ‘gas’ simply drives the network). This network which drives innovation opens up Ethereum to be disrupted by future entrants looking to build upon the existing framework. Bitcoin is largely safe from this threat of new entrants as Bitcoin’s explicit purpose of acting as a digital currency has been effectively accomplished, where future innovative networks can use Bitcoin as an underlying asset.

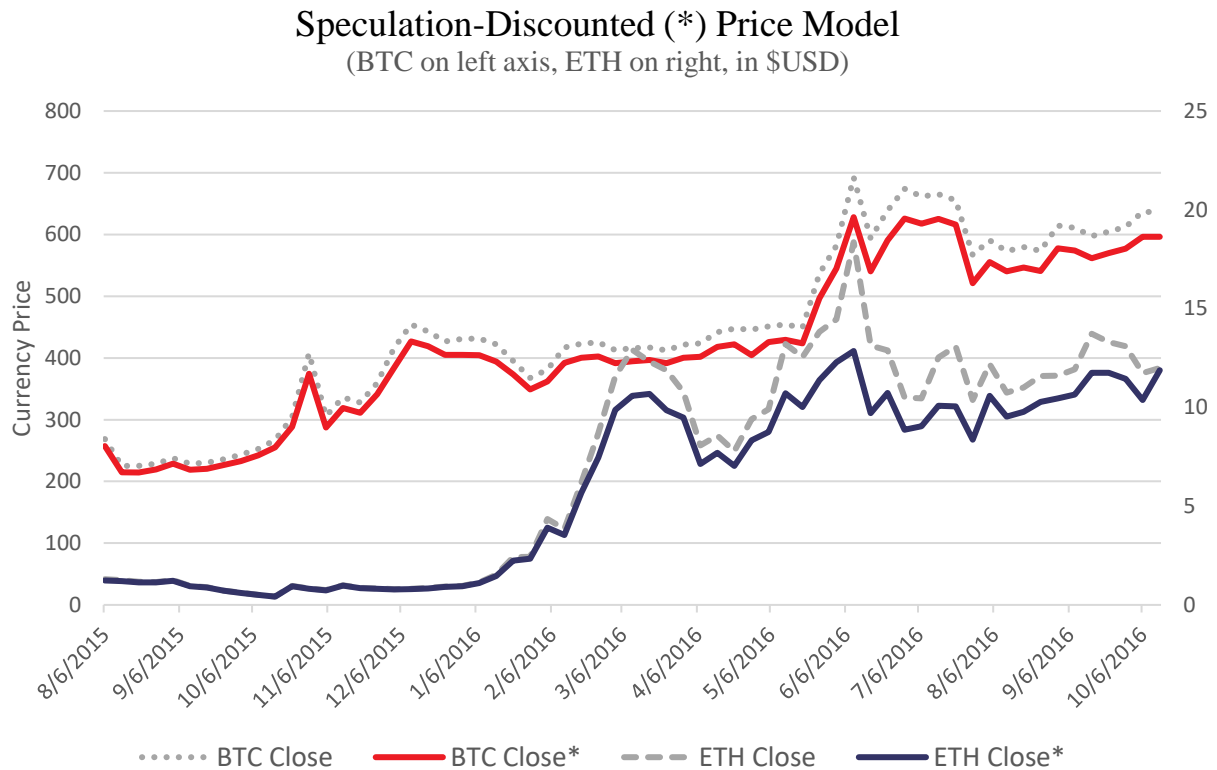
Figure 1. Comparison of BTC and ETH

Bitcoin: Explicit niche, limited range of uses, MVCC, more widely adopted, leverages innovation	Ethereum: Use of 'smart contracts', versatile, Ethereum Virtual Machine, Turing-complete, dramatic growth, IoT, innovation driver, blockchain 2.0
Shared Traits: Cryptocurrencies, anonymous, no need for ‘trust’, blocks are ‘mined’ with increasing difficulty, underlying use of blockchain technology	

Will History Repeat Itself?

Using historical data to forecast values of both Bitcoin and Ethereum in five years proved to be very difficult, as there was insufficient data to project future prices with confidence. When examining the trends in both sets of prices, the 5 year forecast for Bitcoin is **\$2550** which represents growth of **301%**, while Ethereum's forecasted value is approximately **\$88**, which represents growth of **634%**. Both values represent absolutely incredible growth rates due in large part to the dramatic growth driven by hype and adoption in the early stage of the life cycle.

Upon further analysis, the high growth and volatility of both Bitcoin and Ethereum are the result of news, hype, and speculation. This is shown by the extremely high correlation between prices and Google searches for each respective currency. When looking at Bitcoin the time-series correlation between price and Google searches for "Bitcoin" is **0.64**, while Ethereum's correlation is even higher than that, at **0.88**. In order to account for the hype in our regression forecast, the significance of spikes resulting from increased hype and Google searches were discounted by a factor of **30%**. As can be seen in the following figure, prices are significantly depressed when the hype and speculation surrounding each currency is decreased by **30%**. The depressed impact of Google searches led to a growth rate for Bitcoin of approximately **300%** while Ethereum's is reduced to **506%**. Although the reduced importance of hype and speculation does lessen this forecast, Ethereum has clearly experienced more growth in the recent past.



Note that the (*) values show the weekly closing prices as discounted by search traffic in that period. Although Ethereum appears to be the better investment based on this analysis, past results are not indicative of future performance. Additionally, given the highly volatile nature of both these currencies and the lack of extensive history, this forecast cannot be weighted significantly in the final decision matrix.

Out with the old, In with the New

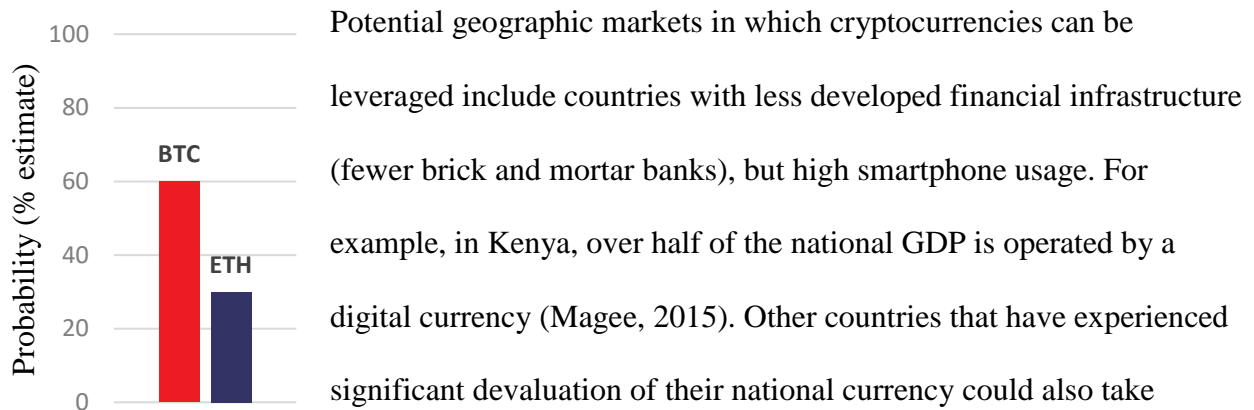
To form a strong forward-looking analysis, interviews were arranged with several blockchain experts as well as one avid cryptocurrency trader. Each of these individuals was polled on the probability of various ‘macro’ events occurring which might affect the demand for each cryptocurrency, they were further asked to rate the probable level of impact each event might have on the two cryptocurrencies using a 5 point ‘Likert’ scale, shown below in Figure 2.

Figure 2. Sample Likert Survey Scale

Emerging Market Uptake					
	Very Low	Low	Medium	High	Very High
Impact on BTC		X			
Impact on ETH			X		

The results of this polling are conveyed in the pursuant macro analysis.

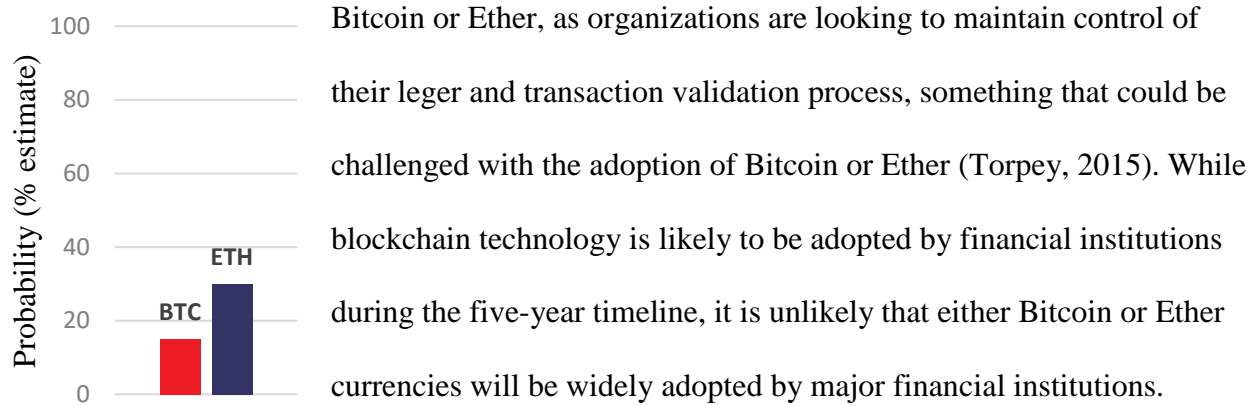
Emerging Market Uptake



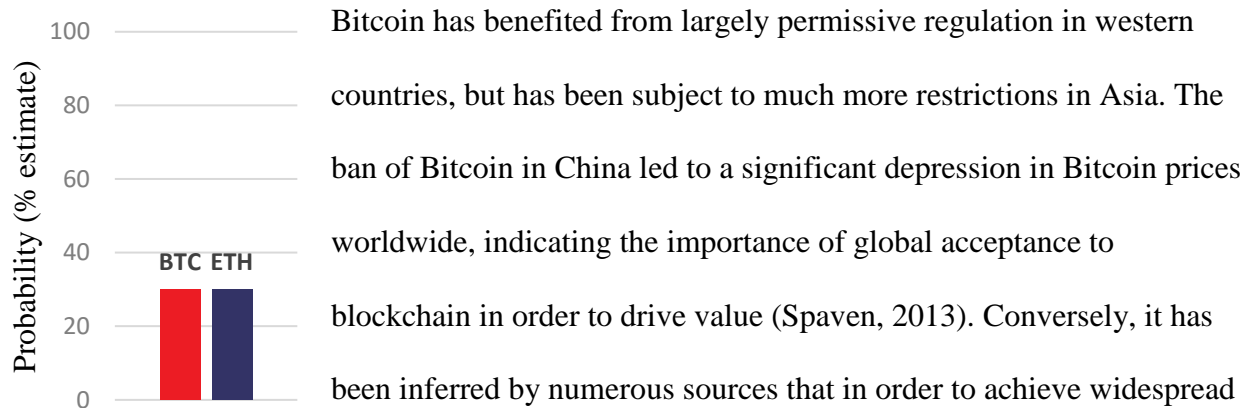
Potential geographic markets in which cryptocurrencies can be leveraged include countries with less developed financial infrastructure (fewer brick and mortar banks), but high smartphone usage. For example, in Kenya, over half of the national GDP is operated by a digital currency (Magee, 2015). Other countries that have experienced significant devaluation of their national currency could also take advantage of efficiencies offered by cryptocurrencies in terms of moving money into and out of the country (Magee, 2015). Overall, the potential impact of emerging market uptake is likely to be more relevant with Bitcoin, which represents the most widely adopted cryptocurrency, with over 14 million Bitcoins in circulation (PricewaterhouseCoopers, 2015) with the highest level of adoption and lowest level of volatility.

Financial Institution Uptake

Financial institutions have shown a willingness to experiment with blockchain technologies to drive operational efficiencies and access previously untapped markets (Torpey, 2015). There has been an unwillingness by large financial institutions to adopt the specific currencies of either

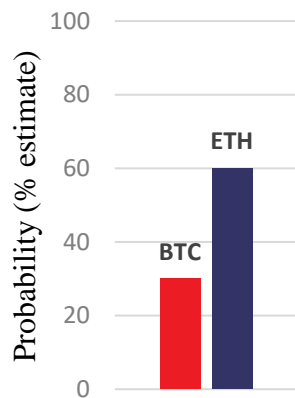


Major Regulation / Deregulation



adoption among financial institutions, regulation must be in place to ensure safe and secure transactions (Spaven, 2015). Global deregulation would impact both Bitcoin and Ether, to varying degrees. Bitcoin, being treated as a currency, would see significant value growth as a result of deregulation, allowing access into numerous market and ease of transactions across borders. While Ether would likely see greater value as a result of widespread adoption and reduction of limitations with the smart contract application. The intrinsic value of a unit of Ether would not necessarily grow, but the widespread adoption of the Ethereum Network would likely grow, leading to greater demand for smart contracts and Ethereum.

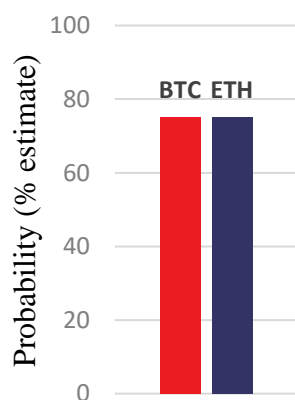
Major Network Compromise



In an ecosystem that promotes highly complex and anonymous exchanges of data, the possibility for major network compromises (i.e. ‘hacks’) seems high. The recent example of the DAO attack causing 3.6 million individual units of Ether to be siphoned into an alternate DAO indicates the possibility and potential severity of such hacks (Siegel, 2016). While the possibility of a ‘51% attack’ in which a majority

stakeholder can significantly impact the value of Bitcoin, the possibility of a major hack is unlikely thanks to the rigid framework of Bitcoin and the relative lack of widespread utility, the only notable exception being Bitcoin Exchange failures as in the case of the Mt. Gox meltdown. Conversely, Ether has already experienced a significant hack, leading to the fork between Ethereum and Ethereum Classic. More freedom, more nodes, and more risk is inherent in the Ethereum Network, and as such, the risk of a major hack is much higher. There is some risk of major hacks regarding the various exchanges in which both Bitcoin and Ethereum are traded. These hacks while not typically indicative of flaws with the cryptocurrency’s code, have historically shown to impact the price of each currency (Nakamura, 2016).

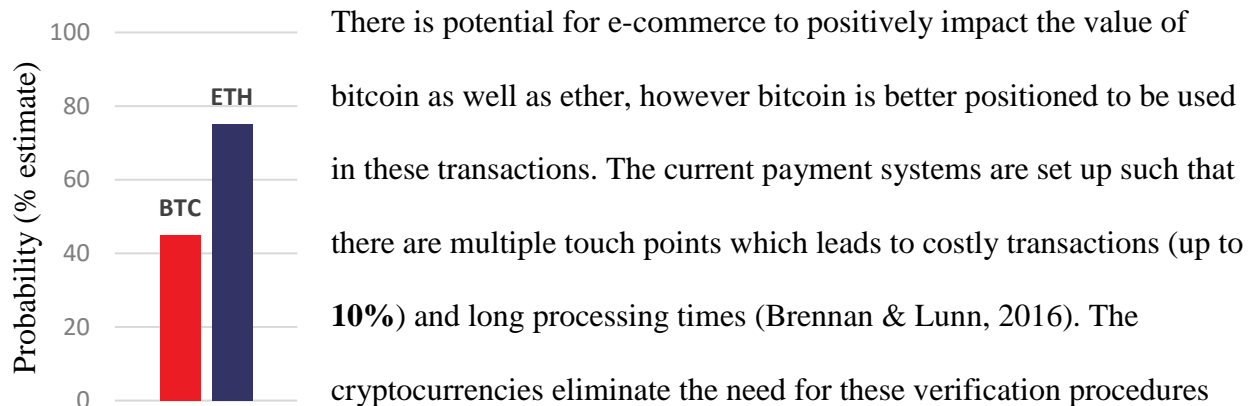
Global Economic Event (Business Cycle)



Bitcoin has utility strictly as a digital currency. As such, Bitcoin can be expected to have an inverse relationship to the state of the global economy. Places lacking in financial infrastructure or highly inflated currencies are more likely to identify Bitcoin as an alternative measure for transacting (Magee, 2015). Although Ether should also bear an inverse relationship to the global economy due to these same factors,

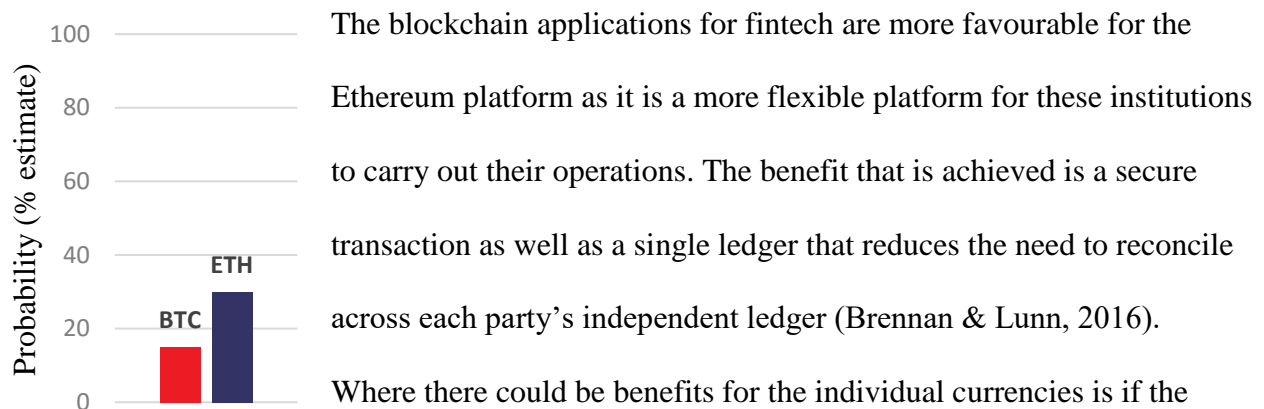
the magnitude of this relationship would likely be lessened due to the wide array of uses, and the more innovative nature of the Ethereum Network. Where Bitcoin values are likely to act in the same manner as commodities, Ether value should relate more closely to widespread adoption of the network and smart contracts.

E-commerce Uptake



and substantially reduce the transaction time. Bitcoin appears specifically useful to minimize these costs, and while the greater potential for hacks and security issues as a result of complexity for Ethereum, the likelihood and magnitude of impact would be less significant for Ethereum's versatile network.

Financial Technology ('Fintech') Uptake



Where there could be benefits for the individual currencies is if the fintech companies would like to increase liquidity in low liquidity markets, however this is a

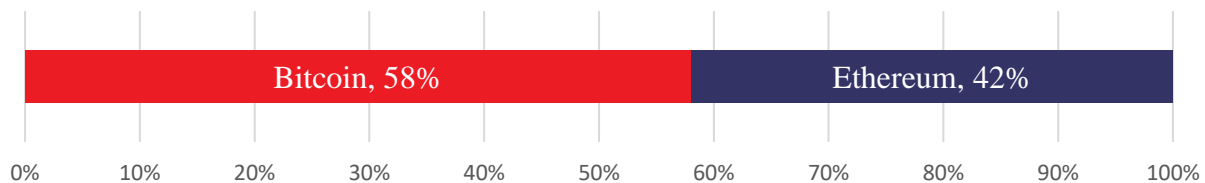
relatively small opportunity. Due to the wider range of application for the Ethereum smart contracts, we have inferred that the likely impact of Fintech adoption would be greater for Ethereum as they can carry out applications in addition to leveraging the benefits of Bitcoin as a cryptocurrency.

Quantitative analysis

To compile a quantitative analysis, several **simplifying** assumptions were made to assist with the creation of a 5-year predictive model for the price of each cryptocurrency. These assumptions can be seen in the Appendix.

A Monte Carlo simulation was compiled to project the impact of various events occurring within a single time-series simulation. A total of 100 simulations were run to compile an expected return on each currency after 5 years using a set of four operations to drive the computation. These operations and an example of the simulation can be seen in the Appendix. The results are shown below, with Bitcoin outperforming Ethereum in 58 out of 100 simulated worlds. This is due in large part to the high variance of outcomes for Ethereum and a wider range of factor probabilities due to a less focused potential use case.

Figure 3. Monte Carlo Win Rate



Investment Strategy

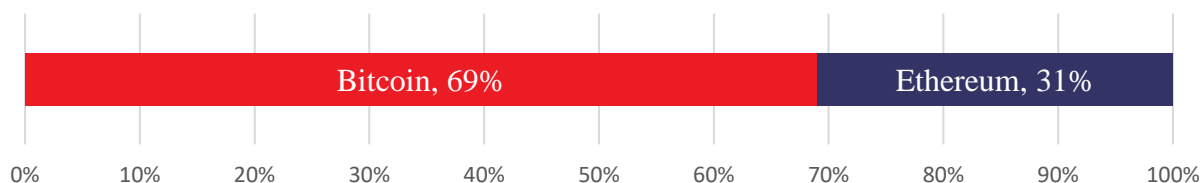
Combined Model Results:

To take into account the various analysis that we performed we have given a weighting to each analysis and used this weighting to allocate the funds of the crypto portfolio. The result of the regression analysis are quite positive, though as stated, we need to heavily discount its result in the overall portfolio decision criteria due to its limitation and has only been given a **5%** weight.

Due to the forward looking nature of the Monte Carlo analysis and its ability to incorporate a multitude of factors that could potentially play out over the next five years; we have allocated the remaining weight to the results of this analysis. Additionally, to increase the rigor we have come up with three different sub-criteria for the results of the analysis. The first was to compare each of the 100 simulations that were produced to determine which cryptocurrency had a higher expected return and to tally the number of times that each currency had a higher expected return than the other. Since this result shows which currency is more likely to have a higher return over the five-year period, we have given this section of the analysis a **40%** weight. We also wanted to incorporate an element of risk aversion in the investment decision, therefore we looked at the number of times each investment had a negative return over the five-year period. This element of the investment criteria was given a **25%** weight. Lastly, we wanted to ensure that the portfolio would be generating a healthy expected return so we took the average of all of the expected returns to produce a likely expected return for the duration of the investment. The result of this evaluation is given a **30%** weight. The table below shows the impact each of these weightings had on the portfolio.

Analysis Type	Weight	Result – BTC	Result – ETH	Impact on Portfolio
Regression	5%	300% growth over 5 years	506% growth over 5 years	0% to BTC 5% to ETH
Monte Carlo – Compared Worlds	40%	58 (wins)	42 (wins)	23.5% to BTC 16.5% to ETH
Monte Carlo – Expected Losses	25%	38 (losses)	46 (losses)	15.5% to BTC 9.5% to ETH
Monte Carlo – Avg Expected Return	30%	42% (return over the next 5 years)	20% (return over the next 5 years)	30% to BTC 0% to ETH
Total	100%			69% to BTC 31% to ETH

Figure 4. Final Portfolio Allocation



As seen from the results of the analysis, bitcoin is consistently the better performer however, ether has proven that it should also warrant an allocation of the portfolio. All things considered, we should invest 69% into BTC and 31% into ETH in order to maximize our return over the next five years.

With this allocation, the **expected value of this portfolio** after five years is;

$$(1.42 * 0.69) + (1.20 * 0.31) * \$1\text{million} = \$1,351,800$$

Conclusion

With the advent of blockchain and cryptocurrencies being as new and revolutionary as it is, predicting the five-year projected value of either Bitcoin and Ethereum requires numerous factors to be considered. Through a combination of qualitative research conducted through interviews with industry professionals, linear regression, and a Monte Carlo analysis, it can be concluded

that Bitcoin can leverage its existing user base and proven use case is likely to experience more growth in the five-year time horizon. Ethereum, while having a lower expected value has a much greater variance as a result of its strong correlation with speculation, news, and hype. Ethereum's wide range of outcomes, both positive and negative, indicate that it should be included in the investment portfolio to take advantage of this fact.

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Appendices

Quantitative Analysis Assumptions:

- Investor's foreknowledge of BTC and ETH supply schedules largely negates the need to consider supply inflation in this model - as it is already factored into prices.
- Due to investor's price-factored expectations on **future** demand, the underlying tendency of cryptocurrencies prices is to **decline** in the long-run absence of positive news.
- Like weather systems, cryptocurrency demand is a stochastic system and can only be **estimated** in the form of conjunctive probabilities.

Quantitative Analysis - Monte Carlo Simulation:

Four operations were involved in the computation of each Monte Carlo simulation.

1. Compare the % **probability** of the event to a random number (from **0 to 1**) to determine if an event occurs in a given simulation.
2. If the event occurs, it will 'begin' at a random quarterly time period (**T1**) between now and 5 years in the future.
3. The event will continue for a randomly estimated duration, terminating at a later time period (**T2**). Note that for some events (i.e. A 'major hack'), the entire impact is felt in a single quarter.
4. If an event was calculated to be occurring in a given quarter in that simulation, the '**demand factor**' was computed using a **positive/negative variance** to determine the quarterly (compounding) percentage impact on demand from T1 to T2 of that event.

As an example; if a simulation determined that ‘emerging market uptake’ had occurred, it might be found to have begun in the 16th quarter of the simulation, and endured until the end of the simulation in the 20th quarter for one currency, with the event increasing demand by a compound annual growth rate (CAGR) of 3%. In conjunction with the other eight factors, a net impact on demand for that cryptocurrency could be computed in a given simulation (see Figure 7).

Each time-series demand schedule (see Figure 7) would be calculated and compared to the other cryptocurrency performance in that simulation to determine the win/loss percentage for both Bitcoin and Ethereum in one hundred simulated ‘worlds’.

Figure 5. Explanation of Demand Factor weighting

Demand Factor / Macro Event	Impact on BTC	Impact on ETH	Rationale
Emerging Market Uptake	High	High	According to the world bank there are roughly 2 billion ‘unbanked’ adults worldwide. If either of these currencies were able to tap into and serve these markets, demand for their currencies would substantially increase. (The World Bank, 2015)
Ecommerce Uptake	High	Low	Bitcoin is much better positioned to take advantage of the uptake in e-commerce. The reason being that many of these merchants will likely gravitate to the most popular cryptocurrency as a means of payment. Recently, the computing giant, Dell announced that it accepts bitcoin as a form of payment which would indicate that the large vendors are considering this option (Clancy, 2016). If more vendors follow suit it will add to the velocity of bitcoins which should increase its demand.
P2P/Fintech uptake	High	High	Due to the nature of fintech, if either currency was adopted to facilitate these services there would be a significant impact on their demand.
Financial Institution Uptake	Very High	Very High	If major financial institutions were to facilitate either cryptocurrency’s allocation (i.e. lending or deposits) then there would be a substantial impact on the demand of these currencies. This would mainly stem from the validity and mass distribution channels that these institutions would offer.
Regulation	High	Medium	Regulation could have a positive impact or a negative impact, however whichever way it goes there will be a higher impact on bitcoin. The reason being is that the ethereum network is beyond regulation and therefore there will always be a place for the ether currency to exist. However, if there is regulation that either supports larger scale adoption or limitation to cryptocurrencies then bitcoin will be impacted much more.
Major Hack (-)	High	High	If either of these currencies and the brokerages that help to facilitate their movement were hacked then a substantial amount of trust

			would be lost in these currencies having a high impact on them
Network Overload (-)	Medium	Medium	Given that one of the advantages of cryptocurrencies is their ability to facilitate quick transaction, having a slow network would somewhat impact their value.
Business Cycle	Medium	Low	When business cycles take a turn for the worse many investors look for assets that are not correlated to such economic events. Given that bitcoin is viewed by some as a similar type of asset as gold it could be expected that a turn for the worse would have a measurable impact on the demand for bitcoin. Given the fact that ethers are still not as wide spread, investors are less likely to opt for this cryptocurrency.

Figure 6. Sample Monte Carlo Simulation Results

Simulation 1						
	Rand. Int.	Event Occurrence	Initial Period (T1)	Ending Period (T2)	Random Factor Variance	Random Demand Factor
Emerging market Uptake	0.933941935	0	24	24	5	3.25%
Ecommerce Uptake	0.758359728	0	18	24	7	2.25%
P2P/Fintech uptake	0.060150495	1	16	24	-8	0.00%
Financial Institution Uptake	0.394203795	0	15	24	8	5.00%
Regulation	0.973497336	0	13	14	-5	-1.25%
Major Hack (-)	0.384023431	1	23	24	-2	-15.50%
Network Overload (-)	0.057406039	1	18	21	4	-0.25%
Business Cycle	0.819443479	0	16	21	6	2.75%
Underlying Trend	0.789513872	1	1	24	1	-0.25%

Figure 7. Sample Monte Carlo Time Series

Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225	1.0225
1	1	1	1	1	1	1	1	1	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0.98	0.98	0.98	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1.025	1.025	1.025	1.025	1.025	1	1	1
1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075	1.0075