

The Digital Asset of the Future

Bitcoin & Ether

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ethereum

Introduction & Objectives

This report provides an evaluation of the relative strengths and weaknesses of both Bitcoin and Ether to accomplish our objective of building a \$1 million five-year digital asset investment strategy. To properly assess the two currencies, we evaluated each currency based on its potential for growth and adoption as well as its merit as a digital currency. We identified seven fundamental factors that influence a digital asset's value. All criteria and support for our rankings can be found within the report and appendices.

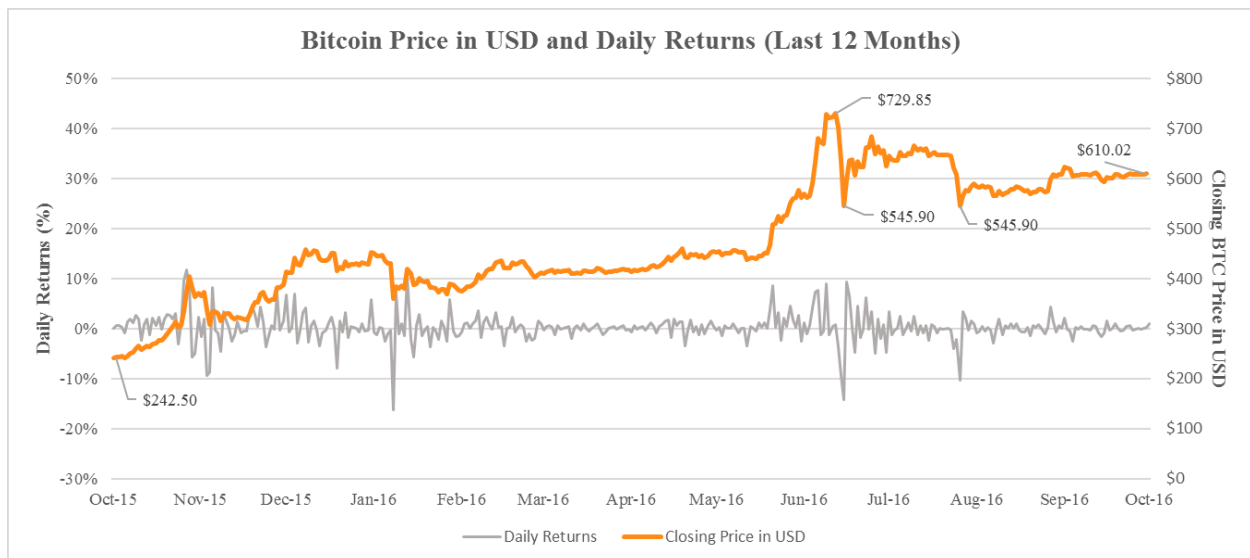
Cryptocurrency

A cryptocurrency is a digital asset that provides a medium of decentralized exchange using cryptography to facilitate transactions. Rather than being backed by a central bank or a government, cryptocurrency is wholly separate from the larger monetary environment. Over the past decade, these currencies have grown in usage and utility as they exhibit advantages relative to conventional currencies. Recently, Bitcoin and Ether have emerged as the clear leaders in the cryptocurrency market. Both utilize distributed ledger technology (DLT), a shared record of all transactions called a blockchain.

Both Bitcoin and Ether are "mined" using tremendous computer resources to run trillions of computations that process and catalogue a batch of transactions which, when fully-processed, will become the next block in the blockchain. After the block is processed, currency is awarded to the miner who has processed the block. This process is known as Proof of Work¹.

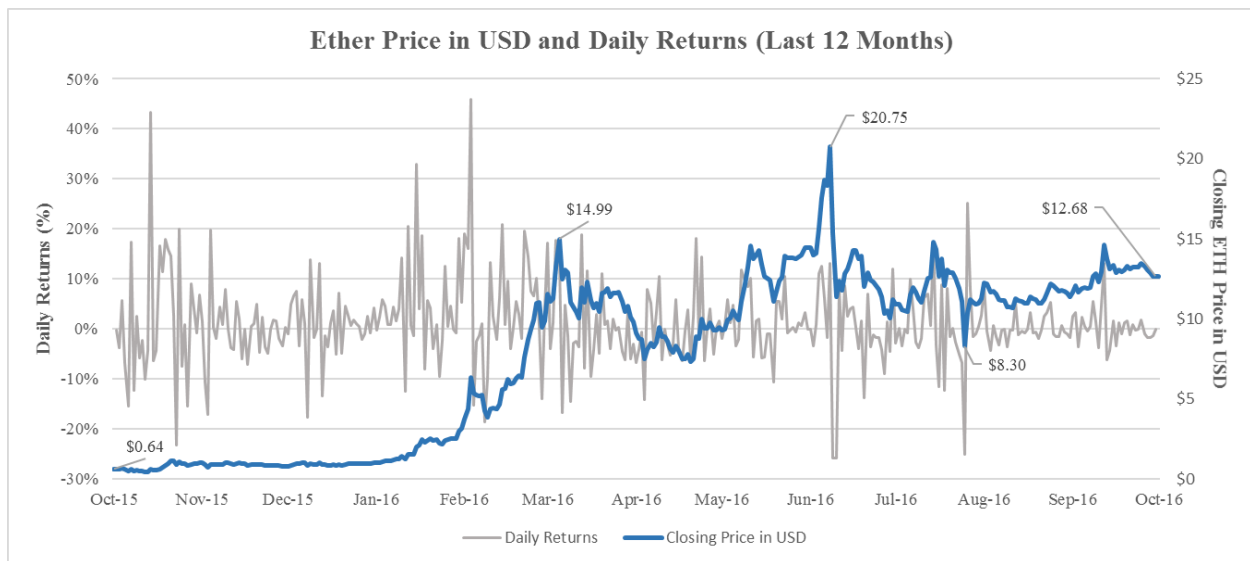
Bitcoin

Bitcoin is the most widely used and accepted digital currency. Its first transaction took place early in 2009². Over the past eight years, 14 million Bitcoins have entered into circulation worth \$10.2 billion³. Bitcoin can now be used to purchase goods and services from retailers such as Home Depot, Intuit, Square, and Uber⁴. Acceptance rates and demand have risen in recent years but the question remains whether Bitcoin will remain the dominant digital asset over the next five years.



Ethereum and Ether

Ether is a newcomer to the digital currency space. First available in August 2015, it differentiates itself from Bitcoin by being part of a wider, blockchain-based network known as Ethereum. As a currency, Ether is used as a form of exchange and reward for work completed within the Ethereum network. In the last year, the value of one Ether has increased an astounding 1750% and currently has total value in circulation of \$1.2 billion⁵. Ether's meteoric first year rise in value has caught the attention of the tech and cryptocurrency world.



The success of the Ethereum network is not synonymous with an increase in the value of Ether. Multiple scenarios exist where DLT-based apps built using the Ethereum network could thrive without Ether’s value matching its growth. For example, Ethereum’s development community may adopt a monetary policy that keeps Ether’s price from increasing in order to allow developers and contributors to affordably purchase Ether. Ethereum’s developers do not appear to be in the business of growing Ether value, rather they are in the business of growing a decentralized network servicing many industries.

Analysis

Evaluation Methodology & Inadequacies of Conventional Methods

Traditional quantitative evaluation techniques used to guide investment decisions are inadequate to form a sufficiently educated digital investment strategy. Cryptocurrencies have no financial statements, cash flows, or historical dividend payments to analyze like a typical corporate investment would have. Cryptocurrencies also lack many of the metrics used to value fiat currencies such as economic indicators (GDP, CPI etc.), official fiscal and monetary policies,

international trade records, discernable political climates, etc. Thus, traditional methods for both equity analysis as well as foreign exchange trading were not applicable.

We attempted to draw correlations between Bitcoin and Ether prices and larger indices and commodities such as the S&P 500, Shanghai Stock Index, EAFE (all-world ex-US ETF), and gold to see if there was a potential hedging opportunity. Bitcoin showed no correlations. Ether correlates positively with gold and correlates negatively with all three tested indices. However, the correlations are not clear enough to warrant a hedging strategy. Bitcoin and Ether showed no correlation with each other (t-statistic: 0.45). We ultimately concluded that we could not base a digital investment strategy on this covariance analysis considering the weak correlations over short periods of time. Furthermore, a purely statistical analysis over such a short period of time fails to capture the various strengths, weaknesses, opportunities, and risks that both Bitcoin and Ether display. The detailed statistical analysis can be found in Appendix A.

Given the limitations of a purely quantitative approach to determine our strategy, an aggregated ranking framework based upon the key factors influencing the success or failure of a digital currency was a logical way to approach our investment. The factors that we concluded are the most influential in determining whether Bitcoin or Ether would be the digital asset of the future are as follows:

Fundamental Attributes	
1	Platform Stability
2	Demand
3	Security
4	Volatility
5	Sentiment
6	Liquidity
7	Supply

The Fundamentals Analysis section of the report demonstrates our criteria and subsequent



evaluation for both Bitcoin and Ether. For each fundamental attribute both currencies are awarded a ranking from 1 to 5 based on a ranking system outlined for each criteria. These individual rankings were then aggregated to direct our investment strategy.

Fundamentals Analysis

Platform Stability

In order for decentralized market activity to truly be possible, the currency used in trading must be stable in both form and function. Investors in cryptocurrency, or any other asset for that matter, should be able to reasonably expect that their investment today is functionally identical to what it was yesterday and what it will be tomorrow.

Ranking Criteria: Platform Stability	
5	Currency has retained its original form and exists as it was intended; major change highly unlikely
4	Currency is still in original form but slight risk of slow changes to form and function do exist
3	Small changes to form and function have occurred with future change likely
2	Moderate risk of future changes to protocol and function occurring with little warning
1	Currency displays a high risk or even a history of rapid changes to function or underlying protocol since inception

Bitcoin

The Bitcoin currency was designed as a digital currency and to this day it functions as such. This is partly due to the fact that major functional changes require the consent of thousands of Bitcoin-holders worldwide⁶. One drawback of executing a transaction with Bitcoin is the slow processing time. Typically, a transaction takes 10 minutes to fully execute. Technically, the transaction protocol could be updated but the required consensus has prevented this change from being made. This kind of consensus makes changing the currency quite slow but also functionally stable.

Unfortunately, circumventing the requirement of getting all Bitcoin holders on board is possible. This hypothetical event is known as a 51% Attack. A 51% Attack is possible if a single entity or group of entities gained a majority control of all Bitcoin mining resources, or computational power. The coordinated group would gain the ability to dictate which future transactions are and are not approved and double-spend their own funds⁷.

The risk lies in the fact that roughly 70% of Bitcoin mining originates in China⁸ and roughly 50% stems from four large Chinese mines⁹. No attempts have been made to execute an actual 51% Attack because such an action would seriously destabilize and devalue the currency that these mines depend on for income. However, the fact remains that this kind of attack could theoretically occur. **Rank: 3**

Ether

As a blockchain-based technology, Ether is also susceptible to 51% Attacks. There are also a number of other stability challenges that Ether faces. In its short lifespan, Ether has endured several major changes to its function and, due to the more centralized nature of the Ethereum network and its developers, the currency faces a high risk of further changes to its programming protocol. In May of 2016 a major Ether-based decentralized venture capital fund known as The DAO was hacked and nearly \$70 million USD worth of Ether was stolen. Core Ethereum developers intervened to return the stolen currency by altering the blockchain¹⁰. This caused a rift within the Ethereum community that resulted in the creation of two, non-fungible Ether currencies - Ether (ETH) and Ether Classic (ETC). This split became known as the “hard fork”. Though this move was approved by a majority of ETH holders, the fact that it was possible raises doubts about the currency's long term stability.

Ether was originally scheduled to abandon the Proof of Work template in exchange for a new model called Proof of Stake which would award coins based on current coin ownership. This change was planned to take place in November of this year but after the DAO hack and the resulting currency split, the exact timing of the change is unclear. Major changes such as this summer's hard fork, though done with good intentions, and the looming move to Proof of Stake are legitimate reasons for hesitation when considering buying Ether. **Rank: 1**

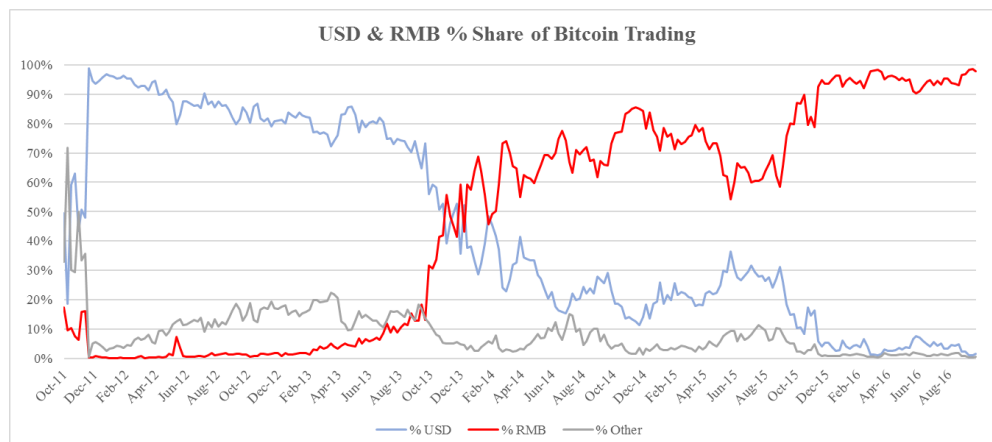
Demand

Demand for digital assets is characterized as any individual or organization's willingness and desire to acquire and/or hold on to a specific digital asset.

Ranking Criteria: Demand	
Growth Opportunities	Risk to Current & Potential Demand
5 Strong prospects for growth	Little to no apparent risk to both current and potential demand
4 Moderate prospects for growth	Risks are minimal for both current and potential demand
3 Multiple weak prospects for growth	Some risks exist to both current and potential demand
2 Weak prospects for growth	Some risks to current and major risks for potential demand
1 No apparent prospects for growth	Major risks to both current and potential demand

Bitcoin

Recently, Bitcoin demand and price have surged, likely due to instability in Chinese markets, as large proportions of recent trading has occurred in China¹¹. Individuals who believe that their local currency is at risk will look for more stable alternatives.



Bitcoin is an attractive substitute as it can transact with ease, maintains identity confidentiality, and is not bound by national borders. Purchasers of Bitcoin include people seeking financial refuge, institutional speculators and traders, retail investors, and those seeking anonymity. We expect several factors to push demand higher in the next five years: First, as digital currencies continuing to move out of obscurity, Bitcoin will be seen as the tried and tested option. Second, the method of using Bitcoin as a means of moving value from one currency to another in times of economic uncertainty will grow in popularity¹². Risks to demand mainly surround regulatory risk and appear to be low to moderate. The current policies of many major governments are encouraging for digital currencies (see Appendix B). Growth Rank: 4, Risk Rank: 4, **Rank: 4**

Ether

Ether has also seen a recent surge in demand as excitement abounds around Ethereum. As awareness of the platform's potential increases, demand for its currency has followed suit. Consequently, Ether has recently been listed on major digital currency exchanges¹³. Future demand for Ether could also be driven by the fact that Ether is more than just a digital currency. Those seeking to be involved in Ethereum will need Ether to operate; this is another avenue for demand growth. Risks include both regulatory risk (similar to Bitcoin) and the risks associated with the start-up nature of Ethereum. Security issues have recently hurt demand and future demand could be affected if these issues persist. Growth Rank: 5, Risk Rank: 3, **Rank: 4**

Security

The blockchain technology that underpins both Bitcoin and Ether is secure. There are no known instances of either digital currency experiencing a hack to the underlying code. Unfortunately, there have been several high-value attacks on the exchanges and networks where these digital assets are traded. Currently, the risk of an attack on an exchange outweighs the risk of the currency itself being attacked¹⁴.

Ranking Criteria: Security	
5	Currencies and exchanges are secure with no history of major attack; principle is insured by a backing party
4	Both the underlying protocols of the digital asset and the exchanges/networks where they are traded are fortified against outside manipulation
3	Minor attacks have occurred; investors have recovered most of their losses
2	History of attack on currency instelf and/or attacks on exchanges; attempts are being made to strengthen defences
1	Currency itself and its blockchain are open to attack; exchanges offer no guarantee of protection or recourse

Bitcoin

The best example of the counterparty risk inherent in the digital asset world is the 2014 hack of Mt. Gox, a Tokyo-based exchange. Roughly \$470 million USD worth of Bitcoin vanished. In the two years since the hack, Mt. Gox declared bankruptcy and less than a fourth of the value lost has been returned to the original owners¹⁵. This episode highlights the risks of a currency that is not centrally backed or insured. While the larger exchanges have become more secure, the risk of hacks and loss of Bitcoin still exists with less sophisticated exchanges. Last summer the Bitfinex exchange was attacked and 120 thousand Bitcoin (worth roughly \$66M USD at the time) was stolen¹⁶. After each hack, the value of Bitcoin responded negatively. Even if coins are returned to the original owners, the value lost as a result of the uncertainty this introduces into the market could curb investors' enthusiasm for cryptocurrency. At the time of the Mt. Gox hack, one Bitcoin was worth \$604 USD. By the end of 2014, the value had dropped

49% to \$310 USD. Only now, after 22 months, has Bitcoin recovered from this dramatic swing in value. **Rank: 3**

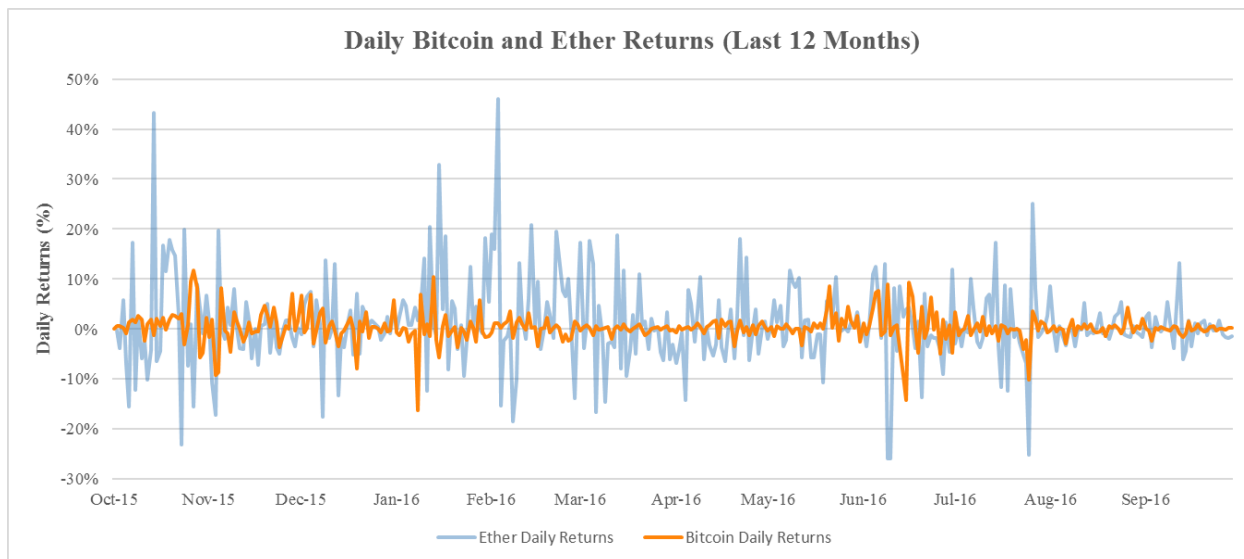
Ether

Ether has also experienced its share of hacking episodes. The most serious was the DAO hack which resulted in the subsequent hard fork and creation of two parallel Ethereum-based currencies. This hack illustrated the two primary threats to the security of the currency. First, is the obvious hostile actions of outside entities. The flexibility of the Ethereum network can be seen as both an opportunity and a weakness. The hack was possible partly due to Ethereum's "large attack surface" caused by the network's flexible nature. Even now, Ethereum and the Ether currency are under a barrage of denial of service attacks coming from disgruntled users unhappy with the handling of the DAO hack¹⁷. These attacks bog down the network and slow the speed of transactions. Second, while the Core Ethereum developers do not pose an outright threat to the security of the currency, their influence on the currency introduces some uncertainty over Ether's future. **Rank: 2**

Volatility

*Volatility is the degree of variation of trading prices over time as measured by the standard deviation of returns. We assess the digital asset's volatility by analyzing past years' price ranges, means, and standard deviations.*¹⁸

Ranking Criteria: Volatility	
5	Annualized return risk below 12.24% (S&P500 ARR)
4	Price change within $\pm 25\%$, Annualized return risk between 12.24-14.81% (S&P500 - Gold ARR)
3	Price change within $\pm 100\%$, Annualized return risk between 14.81-22.69 % (Gold - SSE ARR)
2	Price change within $\pm 300\%$, Annualized return risk between 22.69-100%
1	Price change greater than $\pm 300\%$, Annualized return risk over 100%



By analyzing price range over the past year, we observe a change of 216% in Bitcoin and 4,348% in Ether:

Price Range (1 Year)			
	Low	High	% Change
Bitcoin ¹⁹	\$ 241.34	\$ 762.75	216%
Ether ²⁰	\$ 0.44	\$ 19.57	4348%

By analyzing the Annualized Return Risk, we observe high risk for both. Ether's risk is much higher at 217%, while Bitcoin's risk is 63%:

Annualized Return Risk (1 Year)	
	ARR
Bitcoin	63%
Ether	217%

At an equal weighting for price change and ARR, we arrive at the following ranking:

Volatility Composite Ranking			
	Price (50%)	Mean/Std. Dev (50%)	Rank
Bitcoin	2	2	2
Ether	1	1	1

Sentiment

Sentiment includes analyzing the sentiment of the general public, digital currency community, and governments.

Ranking Criteria: Sentiment		
General Public	Government	Technical Community
5 Very well known and accepted	Approving of or don't have any interest	Tech community is growing and vibrant
4 Well known and somewhat accepted	Observant but tolerant	Strong support is observed
3 Some knowledge and understanding	Some are threatening to take action	Niche community but growing
2 Few know about it and are confused	Major gov'ts threatening and some taking action	Niche community and is shrinking
1 The public is against it	Regulations and bans are present from major gov'ts	Tech community has moved on

Bitcoin

Bitcoin holds the honor and advantage of ushering in the digital currency era. Public sentiment has grown slowly but consistently despite the previously mentioned security issues. The digital currency community trusts and relies on it as the standard. Multiple countries have some level of restriction on the currency²¹, but most major economies are tolerant or apathetic towards bitcoin. We see this government tolerance and apathy towards Bitcoin as positive for sentiment (see Appendix B) **Rank: See Table Below**

Ether

Ether is not well known or widely understood due to the complexity of the wider Ethereum network and its sheer infancy. Even its creators and developers have a difficult time explaining what it is²². This has hindered its adoption within the technical community. The aforementioned security issues that Ethereum has faced have hurt sentiment and could eventually destroy sentiment if they continue. Paradoxically, we feel that Ether holds a regulatory advantage over Bitcoin due to its complexity. A government will be hard pressed to regulate an asset it does

not understand as Ether is not explicitly labeled or branded as a currency and has functions beyond simple exchange²³. **Rank: See Table Below**

Sentiment Composite Ranking	Bitcoin	Ether
General Public	4	2
Government	4	5
Technical Community	4	3
Composite Rank (equal weight)	4	3.3

Liquidity

For digital assets, liquidity is how quickly it can be bought and sold in the market without affecting the asset's price²⁴. We assessed digital asset liquidity in terms of transaction time, cost, and the ease of exchange in all market conditions.

Ranking Criteria: Liquidity	
5	Zero transaction time and cost, extremely high trading volume in both good and bad markets
4	Transaction time under 1 minute, transaction cost under 1% (below foreign transaction fees 1%-3%) ²⁵ , high trading volume in both good and bad markets
3	Transaction time under 2 hours (Alipay transfer), transaction cost under 3% (same as foreign transaction fees 1%-3%). High trading volume in a good market, moderate trading in a bad market
2	Transaction time under 24 hours (venmo & bank wireless transfer), transaction cost under 3.97% ²⁵ (ave. credit card transaction fees). moderate trading volume in either bad or good markets
1	Transaction time over 1 business day (bank to bank transfer), transaction cost over 3.97%, low trading in both a good and bad market

We assessed average transaction costs, transaction times, market cap, and daily trading volume to determine liquidity rankings:

Liquidity Measures	Bitcoin	Ether
Ave. Transaction Cost ^{26, 27}	0.000015%	0.105%
Ave. Transaction Time (sec) ^{28, 29}	720	12
Market Capital (Billion USD) ³⁰	10.2	1.2
Daily Trading Volume (Million USD) ^{20, 19}	60	1.2

The rankings for liquidity can be seen below:

Liquidity Weighting and Ranking			
	Weight	Bitcoin	Ether
Ave. Transaction Cost	30%	5	5
Ave. Transaction Time (sec)	30%	2	4
Market Capital (Billion)	20%	4	3
Daily Trading Volume (million)	20%	5	3
Composite Rank		3.9	3.9

Supply

Understanding an asset's current and future supply is crucial to making an informed investment.

The basic economics of supply and demand hold true for digital currency as with any other good or service.

Ranking Criteria: Supply	
5	Supply of currency in the marketplace is stable and monetary policy of the currency is understood by the market
4	Changes in supply of the currency in the marketplace are predictable
3	Supply generally meets demand though there is some irregularity in amount of currency introduced on an annual basis
2	Some amount of regularity in changes in supply though overall currency policies are unclear
1	Significant degree of uncertainty exists surrounding limits of annual coin production and total availability

Bitcoin

Bitcoin's supply is limited to 21 million coins. The rate at which Bitcoin is mined slows with time. This amount, currently 12.5 Bitcoins per block processed, will be halved roughly every 4 years until the 21-million-coin limit has been reached³¹. The limit on total Bitcoins is not governed by any central authority or influence, rather it is imbedded within the underlying blockchain protocol³¹. A finite supply could pose serious issues to the long-term success of Bitcoin if it were a traditional currency. Bitcoin circumvents this issue by being divisible down to units as small as one hundredth of a millionth of a Bitcoin (0.00000001 BTC). **Rank: 4**

Ether

Ether’s developers chose not to emulate Bitcoin’s supply methodology. Currently there is no limit to Ether supply³². Mining functions similar to Bitcoins but rather than 12.5 coins awarded for each block processed, miners of Ether receive 5 coins on a Proof of Work basis. Roughly 10 million Ether will enter circulation this year though annual issuance is capped at 18 million coins³³. As previously stated, the Proof of Work framework is subject to change. What effect the change to Proof of Stake will have on overall Ether supply remains to be seen. Uncertainty surrounding the timing of fundamental mining changes along with the previously demonstrated willingness and ability of Ether’s creators to intervene in the market makes assessing future supply trends difficult. **Rank: 3**

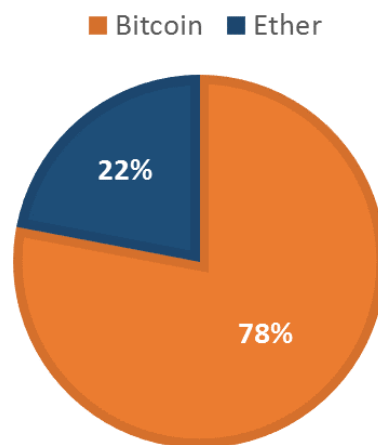
Composite ranking

Aggregated Ranking Framework		
Fundamental Attribute	Bitcoin	Ether
Platform Stability	3.0	1.0
Demand	4.0	4.0
Security	3.0	2.0
Volatility	2.0	1.0
Sentiment	4.0	3.3
Liquidity	3.9	3.9
Supply	4.0	3.0
Aggregated Ranking	23.9	18.2

Conclusion and Final Recommendation

Due to the inadequacies of conventional methods, we created the aggregated ranking framework to guide and inform the overall strategy of our five-year \$1 million digital asset investment. Bitcoin came out as the leader in our final composite rankings, earning a score of 23.9 while Ether earned a score of 18.2, both out of a total of 35.

Two methodologies arise when deciding how to apply these rankings to the investment strategy. The first is to allocate 100% of the investment to Bitcoin given its higher score. The weakness in this approach is that Ether is ignored, despite receiving a respectable score. The second method would involve taking a ratio of the two scores to determine our investment mix. This results in a 57% Bitcoin allocation and a 43% Ether allocation. This approach undermines Bitcoin's superior score and allocates too heavily towards Ether given its uncertain future. Taking the midpoint of the two methods described above and allocating 78% to Bitcoin and 22% to Ether provides a better balance. This midpoint approach has three distinct advantages. First, we allocate the majority of the funds in the higher ranked, proven asset. Second, we are still able to participate in the potential upside inherent in Ether. Third, we diversify our portfolio as the two cryptocurrencies show no correlation.



Appendix

Appendix A: Statistical Correlations and Quantitative Analysis

Though digital currencies have only been available for purchase for a few short years, we wanted to investigate whether or not there were any strong correlations between the returns of these digital assets and other, more traditional investments. We assessed correlation of returns of both Bitcoin and Ether relative to the following four indicators:

- S&P 500³⁴: We chose the S&P 500 as a potential Bitcoin return indicator due to the fact that from 2012-2014, the majority of Bitcoin trading occurred in USD.
- Shanghai Stock Exchange (SSE)³⁵ Composite Index: Since 2014, Bitcoin trading in Chinese Yuan increased dramatically. By 2016, over 90% of Bitcoin trading is conducted in Chinese Yuan.
- EAFE (ex-US ETF)³⁶: We used the EAFE as a proxy for non-US, non-Chinese economic indicators.
- Gold³⁷: Bitcoin and Gold are similar in that they both have a finite supply and are used as a store of value.

Quantitative Methodology

We first calculated the t-statistic of the weekly percentage change of price with each indicator over a one-year period. Generally, any t-value greater than +2 or less than -2 is acceptable. The higher the t-statistic value, the greater confidence we have in a particular coefficient as a

predictor. Low t-statistic values are indications of low reliability of the predictive power of that coefficient. The t-statistics for weekly returns are as follows:

Bitcoin (Past 1 Year Weekly Trading Data)				
Indicator	S&P500	Shanghai	EAFE	Gold
Coeff.	0.37	-0.12	-0.46	-0.23
Std. Err.	0.74	0.41	0.52	0.62
t-stat	0.49	-0.30	-0.90	-0.37

Ether (Past 1 Year Weekly Trading Data)				
Indicator	S&P500	Shanghai	EAFE	Gold
Coeff.	-3.69	-2.5	-3.14	4.73
Std. Err.	2.50	1.35	1.72	2.03
t-stat	-1.48	-1.85	-1.82	2.33

We observed that Bitcoin showed no correlations. Ether correlates positively with gold and correlates negatively with all three tested indices. The results suggest that investors are trading Ether like a rare commodity (like gold) in the last year whereas Bitcoin seems to be trading more like a currency. The correlations are not clear enough to use these digital currencies as hedges for equity markets or for gold.

Appendix B: Current Sentiment of Top Producing Economies

Commentary and Legal Status of Bitcoin in Top Producing Economies	
United States ³⁹	The Commodity Futures Trading Commission, CFTC, classified bitcoin as a commodity and is taxed as such "Bitcoins are funds within the plain meaning of that term".
China ⁴⁰	Private parties can hold and trade bitcoins in China. Regulation prohibits financial firms like banks from holding and trading Bitcoins.
Japan ⁴¹	Japan officially recognizes bitcoin and digital currencies as money.
Germany ⁴²	Bitcoins are legally binding financial instruments that fall into the category of units of account.
United Kingdom ⁴²	The United Kingdom currently does not regulate Bitcoin.
France ⁴³	France has imposed light regulation with regards to sharing identity, capital gains, and regulations for exchanges.
India ⁴⁴	India has stated that it has no plans to regulate Bitcoin.
Italy ⁴²	Italy does not regulate bitcoin use by private individuals and defers to the EU for regulation.
Brazil ⁴⁵	Brazil currently does not regulate Bitcoin.
Canada ⁴⁶	Bitcoin is regulated under anti-money laundering and counter-terrorist financing laws in Canada. It is classified as an "intangible".
European Union ^{*47}	The European Union has passed no specific legislation relative to the status of the bitcoin as a currency. Traditional financial sector regulation is not applicable to bitcoin because it does not involve traditional financial actors.

**Not a country, but included due to its relevance in regulation*

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