Adrian Lee & Partners
ACTIVE ASSET AND CURRENCY MANAGEMENT

Cryptocurrency

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Executive Summary

In this paper we ask, what is a cryptocurrency? and what place (if any) does cryptocurrency have in a diversified portfolio alongside traditional asset classes?

We conclude that cryptocurrency is neither a currency, nor a commodity, and that it does not make a good inflation hedge. Some cryptocurrencies have properties that make them more like art or other collectables than any traditional asset class or good.

While it's difficult to classify cryptocurrency, it may still have a place in a diversified portfolio alongside traditional assets like stocks and bonds. We conclude that in order for this to be the case, cryptocurrency needs to have an expected return of at least 10% per annum.

I
What is Cryptocurrency?

Cryptocurrencies are digital assets which can be transferred electronically on a decentralised blockchain network. A blockchain is a linked list of transaction updates to a virtual digital public ledger. It consists of a group of transaction blocks which are cryptographically linked in a way that means previous blocks cannot be altered, ensuring the security of the system. Decentralisation means that the system is managed across a wide network of computers rather than by a single entity.

Bitcoin

Bitcoin launched in 2009. It was the world's first decentralised digital asset. The virtual coins generated by the Bitcoin network are called bitcoins. Computers in the decentralised blockchain network are rewarded for processing transactions by being issued bitcoins according to an algorithm that limits the ultimate supply. The purpose of bitcoin is to act as a store of value and means of transaction.

Ethereum

Ethereum is a decentralised, blockchain-based computing platform that allows developers to build and deploy decentralised applications.

Typical centralised applications consist of a client program running on a user's device which is served with data by backend code running on a remote server. For example, a Bloomberg program running on a user's computer will be tasked with displaying the user interface on the screen, but all the prices, chart data and news items it displays have been collated, processed and served up by backend code running on servers owned by Bloomberg PLC.
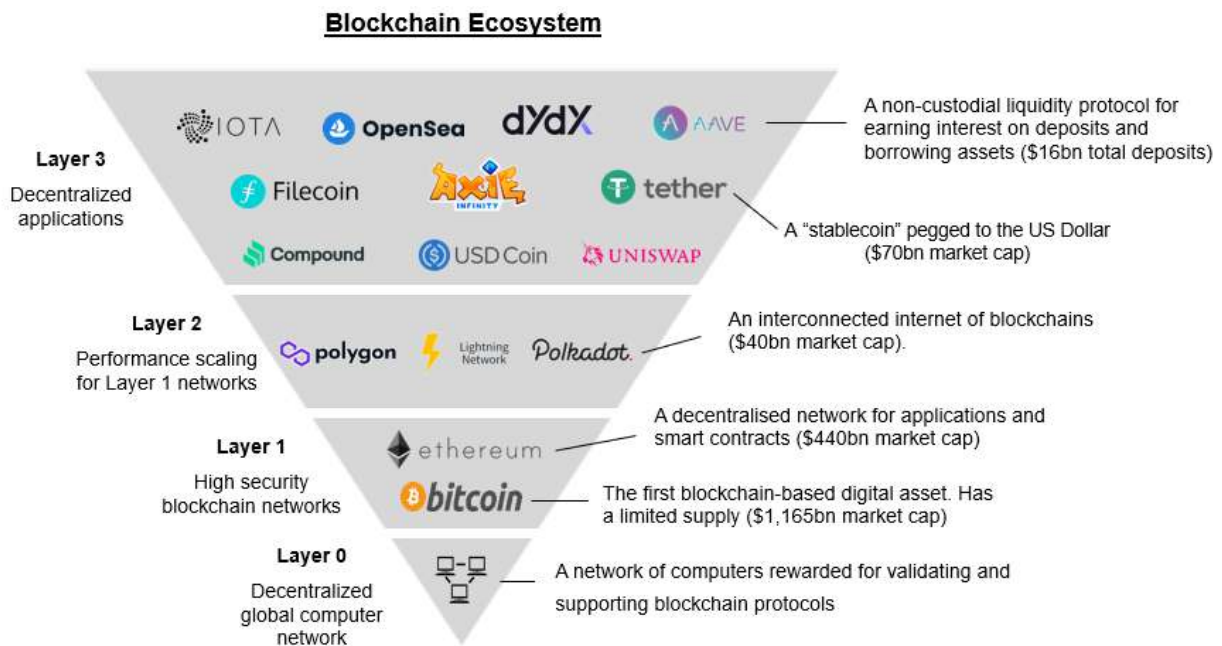
For decentralised applications, the backend code runs on a decentralised network of computers rather than on a central server, and is therefore out of the purview of a single authority. This means that a developer can, for example, create a Twitter-like decentralised application and put it on a blockchain where any user can publish messages. Once posted, no one—including the app creators—can delete the messages.

Ethereum also allows for smart contracts, which are programs stored on a blockchain that run when predetermined conditions are met. They are typically used to automate the execution of an agreement so that all participants can be immediately certain of the outcome without any intermediary's involvement, and the associated time loss. Transactions are trackable and irreversible. For example, smart contracts could be used to replace asset registries, such as

property or auto registries, with smart contracts used to transfer ownership and the public leger securely recording the legal owner of each asset.

In the Ethereum blockchain, computers working in the network earn ether tokens. Unlike bitcoins, the focus of ether tokens is not as a store of value or transaction system, but rather as a system for creating, and paying for, the execution of smart contracts.

The longevity and saturation of the Bitcoin and Ethereum networks, and their coins, have made them leading candidates for product support, such as custody and execution services. But there are many other digital assets or cryptocurrencies existing on blockchain networks.

Blockchain Ecosystem

Layer 3
Decentralized applications

- IOTA
- OpenSea
- dYdX
- AAVE — A non-custodial liquidity protocol for earning interest on deposits and borrowing assets ($16bn total deposits)
- Filecoin
- Axie Infinity
- tether — A "stablecoin" pegged to the US Dollar ($70bn market cap)
- Compound
- USD Coin
- UNISWAP

Layer 2
Performance scaling for Layer 1 networks

- polygon
- Lightning Network
- Polkadot. — An interconnected internet of blockchains ($40bn market cap).

Layer 1
High security blockchain networks

- ethereum — A decentralised network for applications and smart contracts ($440bn market cap)
- bitcoin — The first blockchain-based digital asset. Has a limited supply ($1,165bn market cap)

Layer 0
Decentralized global computer network

— A network of computers rewarded for validating and supporting blockchain protocols

The benefits and uses of cryptocurrency as a means of exchange

Blockchain transactions are effectively instantaneous and can be processed 24/7. They bypass the banking system, avoiding transaction fees. Its proponents talk about its security and transparency; the distributed ledger makes all transactions visible to all users. Because all users can see that each transaction and token is accounted for in the system, they know that no theft is occurring within the blockchain. This builds trust in the system and removes the need to build trust in a counterparty or intermediary for each transaction.

The transparency described above does not mean that users can tell which individuals have been party to a transaction; even if all users know which digital wallets were involved in a transaction,

it can be difficult to connect an individual to a wallet. This anonymity, and the ability to avoid the banking system, makes cryptocurrency useful for black market transactions.

Despite the low fees and instantaneous transactions, the difficulty in finding firms willing to exchange goods and services for cryptocurrency means that law-abiding citizens still have very little practical use for cryptocurrency as a means of exchange. This can only change if cryptocurrency adoption increases dramatically among retailers.

Are cryptocurrencies currencies?

A currency is a medium of exchange and a store of value.

While cryptocurrencies such as Bitcoin may have been intended as medium of exchange, they are not yet easy to exchange for goods or services in most settings. Neither can cryptocurrencies be considered a store of value. Prices tend to be volatile, and as such their investment characteristics are more like risky assets.

So, by the definition of currency above, cryptocurrencies can't be considered currencies.

Are cryptocurrencies commodities?

A commodity is a good that is highly fungible, and is usually a resource serving as an input to the production processes of goods or services.

While many cryptocurrencies are fungible—tokens are equivalent in value and function—it is difficult to argue that any cryptocurrency can be an input to a production process, and so they are not commodities.

However, cryptocurrencies can have several properties in common with commodities. Some may have limited supply (like Bitcoin), for example, or have some cost associated with their extraction or storage (such as electricity supply required to process transactions). Some cryptocurrencies may even have a consumption value, entitling the bearer to the use of some digital infrastructure (e.g., payment of a token may be required to record a transfer of property ownership in a public ledger that serves as a register; the token is destroyed after use).

Despite these similarities, Bitcoin and Ethereum have had low correlations with physical commodities since the cryptocurrencies were launched.

Correlation of monthly returns from Aug 2010 - Sep 2021		Correlation of monthly returns from Mar 2018 - Sep 2021		
	Correlation with Bitcoin		*Correlation with Bitcoin*	*Correlation with Ethereum*
Crude Oil	0.00	Crude Oil	0.11	0.11
Natural Gas	0.08	Natural Gas	-0.15	-0.11
Gold	-0.01	Gold	0.12	0.19
Copper	0.03	Copper	0.12	0.23
Wheat	0.02	Wheat	0.28	0.31
Soybeans	0.10	Soybeans	0.22	0.20
Lumber	0.02	Lumber	0.22	0.33

Source: Macrobond, Bloomberg, AL&P

Are cryptocurrencies a good inflation hedge?

There is no causal mechanism to explain why cryptocurrency <u>should</u> be an inflation hedge:

- Cryptocurrencies aren't inputs into production processes

- Cryptocurrencies are not consumable goods

- There is insufficient evidence so far to determine whether cryptocurrencies have a cyclical pattern that would make them inflation hedges

From 2010 - 2021, Bitcoin's monthly returns have had a correlation of 0.04 with month-on-month changes in the US consumer price index. From 2018 – 2021, Ethereum's correlation with consumer prices was 0.07. Such low correlations make it unlikely that either cryptocurrency would make a good inflation hedge.

Academic research on this topic has led to similar conclusions. Smales (2021) concludes that the positive relationship between inflation expectations and cryptocurrencies is only significant under very specific circumstances. Conlon et al (2021) fail to find clear evidence of inflation hedging, outside of a brief period coinciding with the onset of the pandemic.

If cryptocurrencies aren't currencies or commodities or inflation hedges, what are they?

Cryptocurrencies don't have the characteristics of either currencies or commodities, and they don't represent the ownership of expected future cash flows like equities or bonds. However, they do have an intangible value to people who appreciate their technological and sociological characteristics. This value comes from the subjective appreciation of the technology rather than

any economic driver, and so in this sense cryptocurrency could be compared to art or collectables. As with cryptocurrency, there are niche investors who use art as a diversifying alternative source of returns for their portfolio.

Alternatively, exposure to a cryptocurrency can be seen as a speculative bet that demand for the technology underlying the token will outstrip the supply of tokens. For example, if demand for Bitcoin transactions increases at a faster rate than bitcoins can be mined, then the price of each bitcoin should increase so that the bitcoin supply meets the demanded volume of bitcoin transactions (ceteris paribus). A similar logic can be applied to Ethereum: if demand for smart contract executions outstrips the supply of ether tokens, then the price of tokens should rise.

Because there are no economic reasons that cryptocurrency ought to provide systematic return in compensation for risk, it is difficult to view the tokens as an asset class. However, some investors may view individual cryptocurrencies as sources of idiosyncratic return, like exposure to an individual stock or other individual security. If so, it might be more useful to view cryptocurrency as a potential source of tactical alpha rather than as a strategic investment.

For those investors who see potential returns in cryptocurrency, the question becomes: how high do those expected returns have to be to merit including cryptocurrency in a diversified portfolio alongside traditional asset classes like stocks and bonds?

The following section attempts to tackle this question.

II

Asset Allocation: Stocks, Bonds and Cryptocurrency?

Investment characteristics

Since its launch in 2009, Bitcoin has returned 234% annualised, with an annualised standard deviation of return of 201%. This means that Bitcoin has had a higher risk-adjusted return than stocks over this period. (Bitcoin had an information ratio of 1.2, while the S&P500 information ratio was 1.1.)

Since Ethereum launched, it has been correlated with Bitcoin and had similar high returns and volatility.
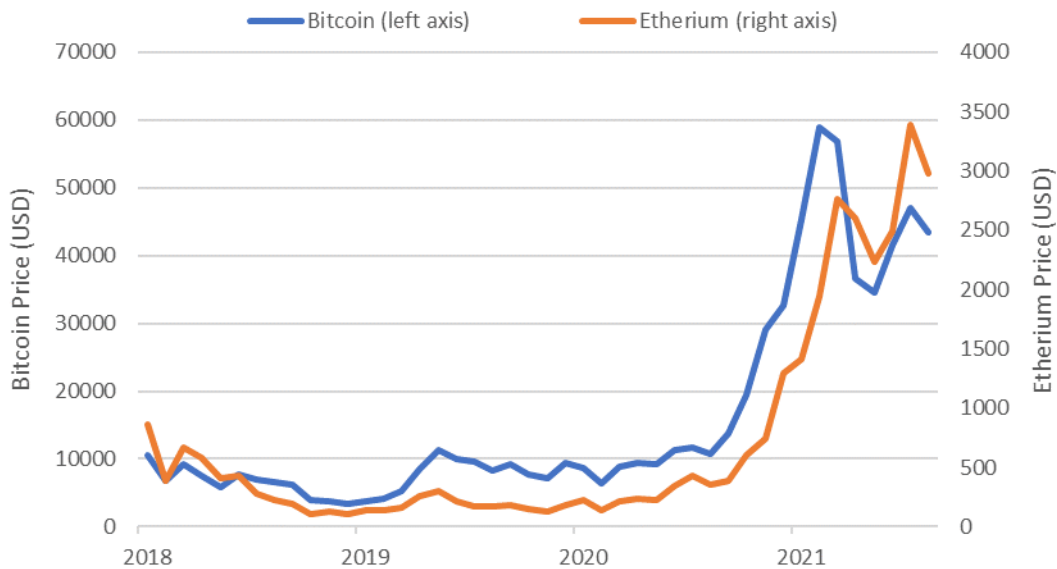

2018 - 2021	Bitcoin	Ethereum	MSCI ACWI	GABI Bond Index
Annual Return (%)	48.5	41.1	12.1	3.1
Annual Risk (%)	83.2	112.5	16.8	4.4
Information Ratio	0.58	0.37	0.72	0.71

Source: Bloomberg, MSCI, JP Morgan, AL&P

The correlation between Bitcoin and Ethereum was 0.75 over this time.

There has been a positive but unstable correlation between Bitcoin and global equities since Bitcoin's launch, but little correlation to bonds, commodities or cash.

Bitcoin Three-year Rolling Correlation with MSCI ACWI
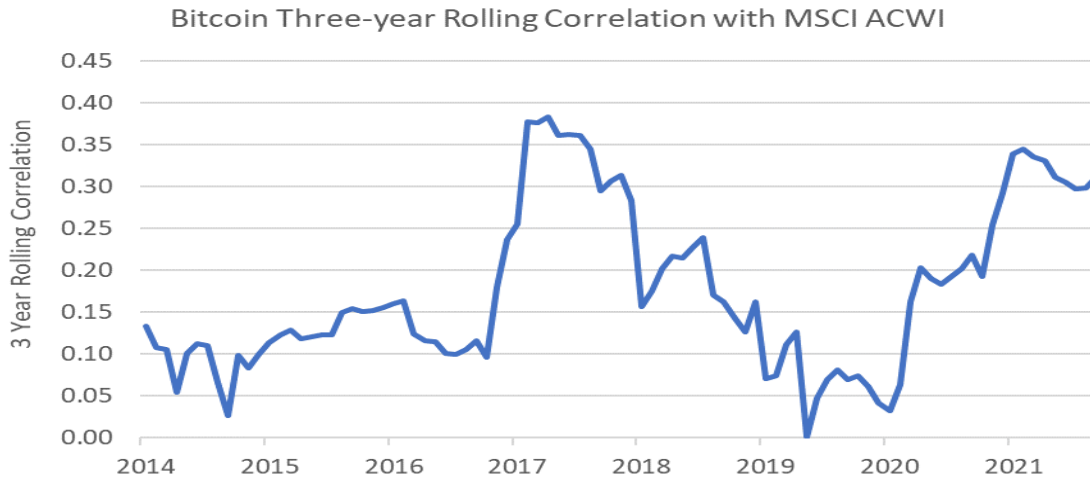
Correlation of monthly returns
from Aug 2010 - Sep 2021

	Correlation with Bitcoin
Global Stocks	0.15
Global Bonds	0.10
Commodities	0.07
Cash	-0.13

*Proxies: stocks, MSCI ACWI; bonds, JP Morgan GABI
Index; commodities, GSCI Reduced Energy Index; Cash,
JP Morgan three-month cash total return index*

What is the expected return required for cryptocurrencies like Bitcoin and Ethereum be included in a diversified portfolio alongside traditional asset classes?

To answer this question, we use a mean-variance optimal framework to determine the portfolio weightings of stocks, bonds, real assets, commodities, and cash. A portfolio targeting 10% annual volatility will be about 60% invested equity and real assets, and 40% invested in fixed income within this framework.

We then add cryptocurrency to the set of available investments, assuming a correlation of 0.1 with equity and an annual volatility of 100%. The chart below shows the mean-variance optimal portfolio weights (y-axis) versus the expected return to cryptocurrency (x-axis).

Mean-variance Optimal Portfolio Weights [1]
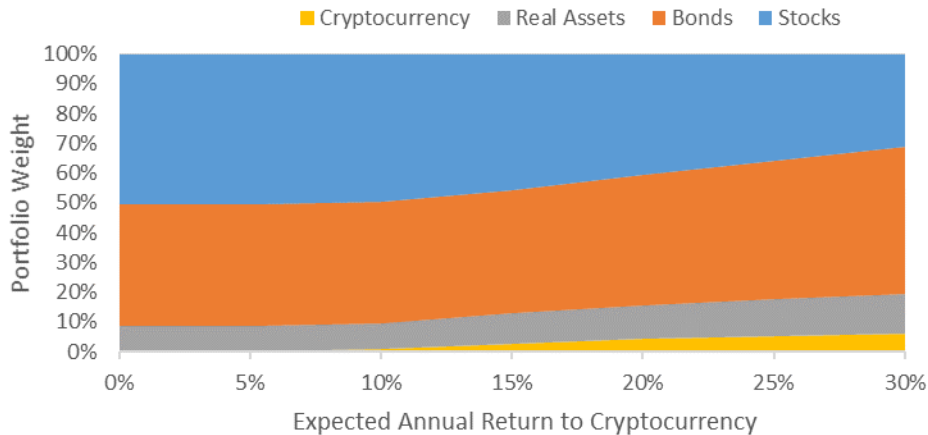
[1] See appendix for details of this calculation   Source: AL&P

The weight of cryptocurrency (yellow area) is non-zero when the expected return is above 10% annualised. (This weight stays relatively small given its high volatility.)

Tail-risks

Traditional asset allocation studies tend to measure risk as some function of market price, such as standard deviation of returns or estimation of value at risk. In the case of cryptocurrency, such measures hide serious tail risks.

If demand for Bitcoin transactions dries up due to competition, market sentiment or market regulation, then there need be no Bitcoin price at all. If demand for smart contract logic execution never materialises, there need be no market for Ethereum. If regulators decide to limit any of the technologies underlying any of these digital assets, demand could dry up overnight.

With these risks in mind, the results of traditional portfolio allocation methodologies including cryptocurrencies should be viewed with more than the usual amount of caution.

Details of mean-variance analysis

The portfolios shown are those that maximise expected return given a target risk of 10% annualised. No leverage or short-selling of asset classes is allowed. The input strategic returns, risks and correlations are shown below.

	Return (%)	Risk (%)
Stocks	8.5	18.0
Bonds	4.5	7.0
Real Assets	5.5	13.0
Commodities	4.0	20.0
Cash	2.0	0.3
Cryptocurrency	*from 0 to 30*	100.0

Correlations

	Stocks	Bonds	Real Assets	Comm.	Cash	Crypto.
Stocks	1.00					
Bonds	0.00	1.00				
Real Assets	0.35	0.05	1.00			
Commodities	0.65	0.00	0.00	1.00		
Cash	0.00	0.10	0.00	0.00	1.00	
Cryptocurrency	0.15	0.00	0.00	0.10	0.00	1.00