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Global Investment Strategy

Strategy Report

May 21, 2021

The Crypto Impossibility Theorem

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- The drubbing that cryptocurrencies have received over the past two weeks is just a taste of things to come.
- Crypto markets will continue to face tighter regulation, as this week's announcements from China and the US Treasury underscore.
- The hope that cryptocurrencies can ever truly "go green" is wishful thinking. Given their decentralized nature, cryptocurrencies require real resources to be expended to permit secure transactions to take place.
- In addition to their technical limitations, cryptocurrencies face a fundamental constraint, which we dub the "Crypto Impossibility Theorem."
- The Crypto Impossibility Theorem states that cryptocurrencies will be viable only if they offer a higher return than equities.
- The assumption that cryptos can generate a return in excess of equities is almost certain to be false since it would require that cryptocurrency holdings rise more quickly than income in perpetuity.
- In the near term, the pain in crypto markets could drag down other speculative assets such as tech stocks. In the long term, diminished investor interest in cryptos will benefit the stock market, as investor attention focuses back on equities.

Cryptos: Can't Have It All

Investors who track the cryptocurrency market might be aware of the "blockchain trilemma." It posits that cryptocurrencies can possess only two of the following three attributes: decentralization, security, and scalability.

Bitcoin is both highly decentralized and reasonably secure. However, because control of the Bitcoin blockchain is distributed across thousands of individual computer nodes, it is also very slow.

The Bitcoin network can barely process five transactions per second, compared to over 20,000 for the Visa network (**Chart 1**).

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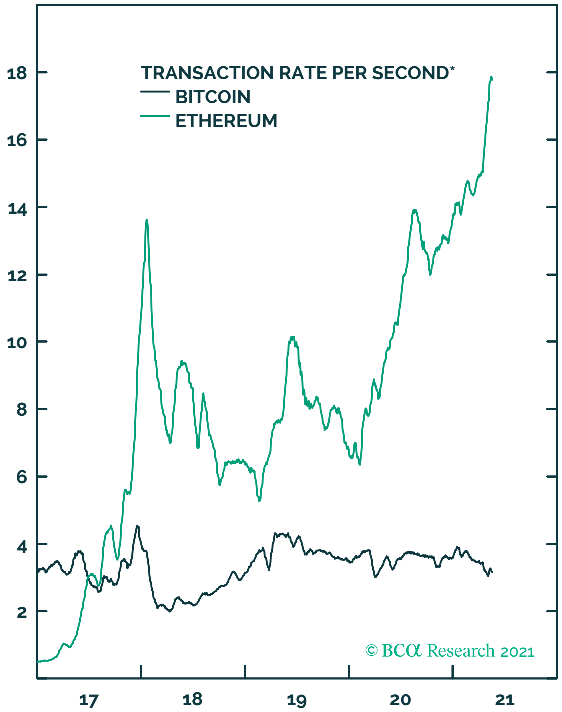
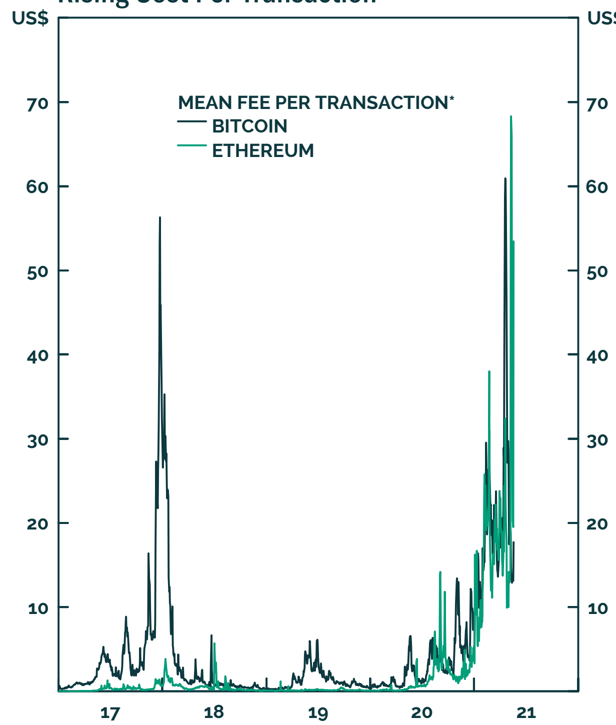
Bitcoin mining consumes more energy than entire countries such as Sweden, Argentina, and Pakistan.

CHART 1
Speed Of Transactions, Or Lack Thereof



* SHOWN AS A 30-DAY MOVING AVERAGE.
SOURCE: COINMETRICS.

CHART 2
Rising Cost Per Transaction



* SOURCE: COINMETRICS.
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The average fee for a Bitcoin transaction is around $30, a number that has risen over the past few years (**Chart 2**).

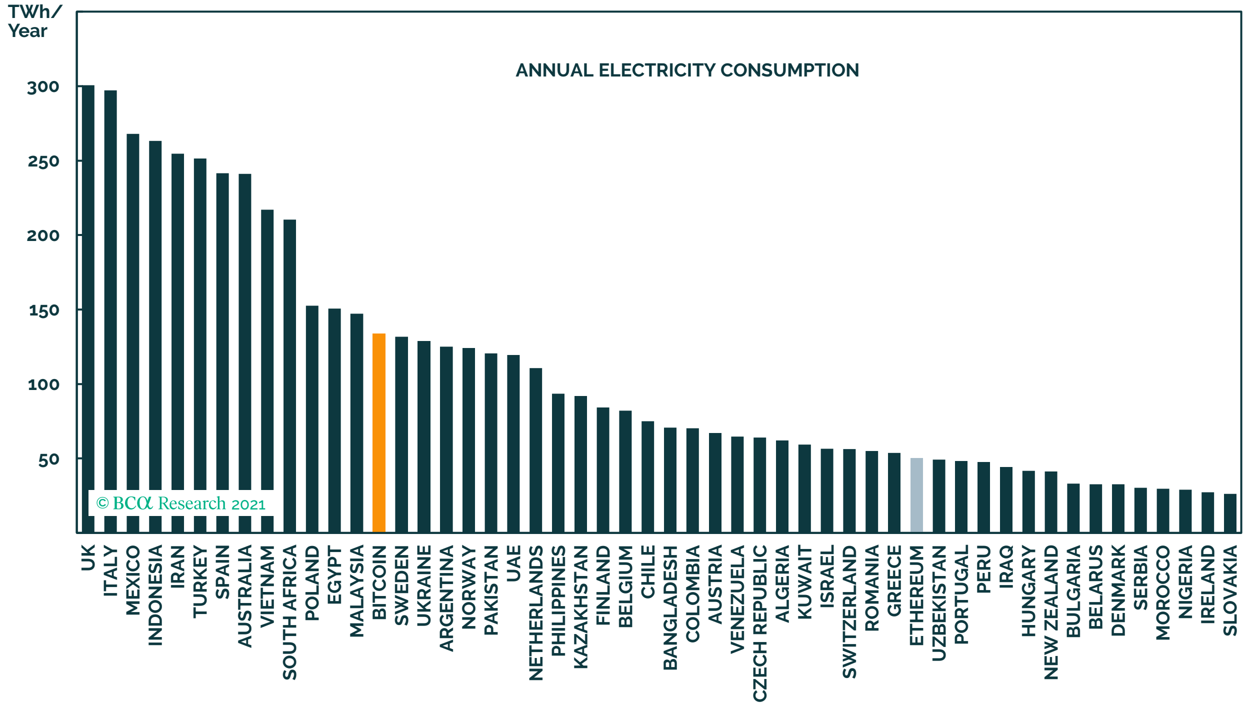
The elaborate puzzles that the Bitcoin algorithm must solve to verify transactions are extremely energy intensive. Bitcoin mining consumes more energy than entire countries such as Sweden, Argentina, and Pakistan (**Chart 3**). About two-thirds of Bitcoin mining currently takes place in China, often using electricity generated by burning coal.

Some claim that Bitcoin and other cryptocurrencies are shifting to renewable energy sources, a trend that will continue in the years ahead. However, this argument misses the point, which is that the "proof of work" mechanism that underpins Bitcoin *requires* that real resources be expended.

Suppose that all Bitcoin mining could be performed entirely for free using solar energy. This would reduce the cost of running a "mining rig," incentivizing more mining. The Bitcoin algorithm operates in such a way that the difficulty of mining coins increases as the total computational power of all miners grows. In this computational rat race, miners would need to purchase more servers with ever more powerful specifications to keep up with their competitors. And semiconductors do not grow on trees. It takes real resources to produce them. As this recent Bloomberg article pointed out, Taiwan Semiconductor generates almost 50% more greenhouse emissions than General Motors.

Like Bitcoin, Ethereum uses the "proof of work" mechanism to verify transactions.

CHART 3
Bitcoin And Ethereum: How Dare You!



SOURCE: US EIA, CAMBRIDGE CENTRE FOR ALTERNATIVE FINANCE, AND ETHEREUMENERGYCONSUMPTION.COM.
NOTE: ELECTRICITY CONSUMPTION VALUES ARE BASED ON THE MOST RECENT AVAILABLE YEAR (2018 OR 2019).

There have been active discussions to shift Ethereum to a "proof of stake" mechanism, which would greatly expedite transactions.[1] However, some have argued that a proof of stake system would degrade security, allowing for "double-spend attacks" where someone transfers coins to someone else but then spends the coins before the transaction is completed.

1 Proof of Work (PoW) and Proof of Stake (PoS) are two methods used to ensure the integrity of a coin's ledger or record of transactions. PoW achieves this by requiring miners (those who add transactions to the ledger) to solve a time-consuming mathematical puzzle. PoS achieves this through a different mechanism, where anyone who stakes their own coin can be randomly selected to add new transactions to the ledger. Those holding or "staking" more coin have a higher probability of being selected.

The Crypto Impossibility Theorem

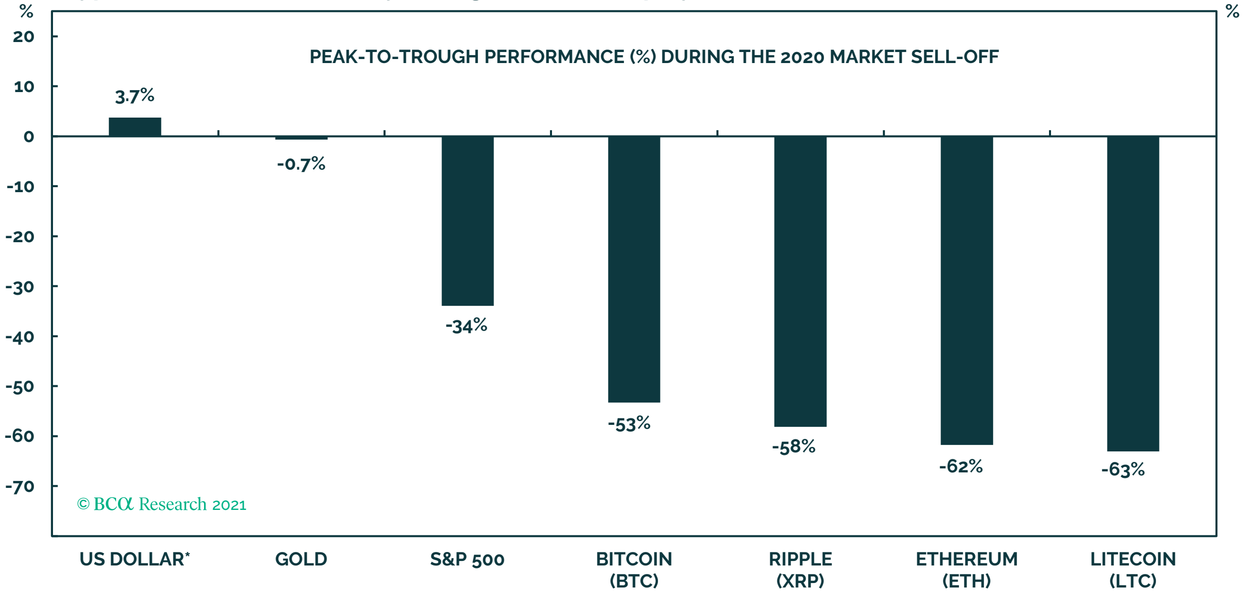
We will not delve any further into the technical nature of the blockchain trilemma other than to note that it poses a serious challenge to the entire cryptocurrency project. Instead, let us highlight another obstacle that has received less attention – one that could be even more damaging for the prospects of cryptocurrencies in the long run.

Let us hyperbolically call it the "Crypto Impossibility Theorem." The Crypto Impossibility Theorem states that a cryptocurrency will be viable only if it offers a higher return than equities. As we

Why would anyone choose to hold a cryptocurrency if wages and prices are denominated in fiat currencies such as US dollars or euros?

CHART 4

Cryptocurrencies Fared Badly During Last Year's Equity Sell-Off



* BROAD NOMINAL TRADE-WEIGHTED DOLLAR. SOURCE: FEDERAL RESERVE.
NOTE: BARS DISPLAY PEAK-TO-TROUGH RETURNS FOR THE S&P 500 (FEBRUARY 19-MARCH 23) AND RETURNS FOR OTHER ASSETS CORRESPONDING TO THE BITCOIN PEAK-TO-TROUGH PERIOD (FEBRUARY 14-MARCH 12).

discuss below, the assumption that cryptos can generate a return in excess of equities is almost certain to be false since it would require that cryptocurrency holdings rise more quickly than income in perpetuity. This implies that the value that investors currently attach to cryptos will turn out to be illusory.

To see the theorem in action, recall that money serves three functions: As a unit of account, as a medium of exchange, and as a store of value. It is doubtful that anyone seriously thinks that the price tag on a box of cereal will ever be displayed in units of Bitcoin, ether, or any of the various dog coins currently in vogue. Thus, we can scratch "unit of account" off the list of possible crypto uses.

What about medium of exchange? One can imagine a scenario where the prices of goods and services are still listed in dollars, but one may transfer the equivalent in cryptocurrencies to purchase them. However, this raises an obvious question: Why would anyone choose to hold a cryptocurrency if wages and prices are denominated in *fiat* currencies such as US dollars or euros? The only possible answer is that people must see cryptocurrencies as fulfilling the third function of money, namely being a store of value.

Would people be willing to hold crypto-currencies if their prices generally moved sideways? It is doubtful. Cryptocurrencies are risky. Cryptocurrency accounts are not subject to deposit insurance. Crypto prices are also extremely volatile. During the pandemic, the S&P 500 fell by 34%, but the price of Bitcoin sank by an even greater 53%. Other cryptocurrencies fared even worse. In contrast, the trade-weighted US dollar strengthened by about 4% while gold prices only fell marginally (**Chart 4**).

TABLE 1
Equity Returns And GDP Growth

	S&P EARNINGS* (ANNUALIZED GROWTH)	S&P DIVIDEND YIELD* (AVERAGE)	S&P EARNINGS* (ANNUALIZED GROWTH) + S&P DIVIDEND YIELD* (AVERAGE)	S&P TOTAL RETURN* (ANNUALIZED GROWTH)	US NOMINAL GDP (ANNUALIZED GROWTH)
1950-2000	6.3%	3.7%	10.0%	13.5%	7.5%
1950-1980	6.4%	4.0%	10.4%	10.8%	8.0%
1980-2000	6.1%	3.3%	9.4%	17.6%	6.7%
2000-2020	3.2%	2.0%	5.2%	6.6%	3.8%

* SOURCE: ROBERT SHILLER.

Thus, to incentivize people to hold cryptos, the prospective capital gain has to be large enough to offset the inherent volatility in owning these currencies.

This is where the Crypto Impossibility Theorem comes in. Unlike dividend-paying stocks, cryptocurrencies do not provide any income to their holders. Thus, even if cryptos were just as risky as stocks, the price of cryptos would still need to rise more than the price of stocks in order to ensure that investors remain indifferent between the two asset classes. In practice, as the experience of the pandemic demonstrates, cryptos *are* even riskier than stocks. Thus, the expected return on cryptos has to exceed the expected increase in stock prices by more than the dividend yield.

The problem for crypto holders is that this is not mathematically possible. Even if one controls for the rise in price-earnings multiples over time, equity returns have generally exceeded nominal GDP growth (**Table 1**). Hence, if cryptos need to offer superior returns to equities, and if the return on equities is at least equal to nominal GDP growth, then the market capitalization of cryptocurrencies will not only end up rising faster than for stocks, it will rise faster than aggregate national income. In a digital world where people need ever-less money to facilitate transactions, there is no good reason to expect this to happen.

A Fashion Choice

Crypto-optimists might argue that the required rate of return to holding cryptos will decline as the market matures. This is wishful thinking. Equities derive their value from the fundamentals of a company's business. In contrast, cryptocurrencies have no intrinsic value. Their value is whatever others are willing to pay for them.

Not only does this make cryptocurrencies inherently more risky than equities, it also makes them highly susceptible to fashion trends. It is not surprising that many upstart cryptocurrencies have crafted ties with celebrities and other "influencers." The whole point is to get enough people interested in a cryptocurrency to generate a feedback loop of wider adoption, thus allowing the currency's early backers to cash out.

The drubbing that cryptocurrencies have received over the past two weeks is just a taste of things to come.

TABLE 2
Regulation Of Cryptos: What Can And Cannot Be Done

COUNTRY POSITIONS ON CRYPTOCURRENCIES					
COUNTRY	CRYPTOCURRENCIES: LEGAL TENDER?	CRYPTOCURRENCIES: TRADING PERMITTED?	CRYPTOCURRENCIES: OWNERSHIP PERMITTED?	CRYPTO-EXCHANGES	INITIAL COIN OFFERINGS (ICOs)
CANADA	NO, BUT PARTIALLY ACCEPTED	YES	YES	LEGAL, REGULATION VARIES BY PROVINCE	REGULATED
CHINA	NO	NO	YES	ILLEGAL	BANNED
INDIA	NO	YES	YES	LEGAL	BANNED
JAPAN	NO, BUT WIDELY ACCEPTED	YES	YES	LEGAL, REGULATED BY PSA	REGULATED
RUSSIA	NO	NO	YES	ILLEGAL	GREY AREA
SWITZERLAND	NO, BUT WIDELY ACCEPTED	YES	YES	LEGAL, REGULATED BY SFTA AND FINMA	REGULATED
UK	NO, BUT PARTIALLY ACCEPTED	YES	YES	LEGAL, REGISTER WITH THE FCA	GREY AREA
US	NO, BUT PARTIALLY ACCEPTED	YES	YES	LEGAL, REGULATION VARIES BY STATE	REGULATED

SOURCE: VISUALCAPITALIST, CHAIN ANALYSIS, COMPLY ADVANTAGE, AND THE SEC.

In this sense, cryptocurrencies are even more vulnerable to affinity scams than other assets such as precious metals. While apocalyptic warnings of "currency debasement" have long been used to sell bullion, at least with gold and silver, you truly do get something that is in short supply. In the case of cryptocurrencies, while the supply of any individual cryptocurrency may be limited, the overall supply is unbounded. This means that the average price of each currency is likely to rise much less than the aggregate value of all cryptocurrencies, making the entire asset class even less viable over time.

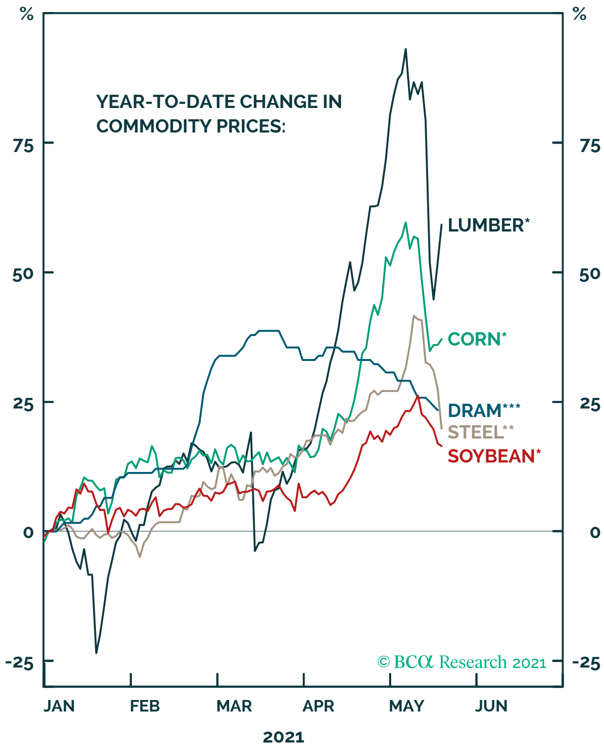
Cryptogeddon

The drubbing that cryptocurrencies have received over the past two weeks is just a taste of things to come. As Matt Gertken and Guy Russell discuss in this week's Geopolitical Strategy report, crypto markets will continue to face tighter regulation (**Table 2**). Just this week, China reiterated its ban on financial companies offering cryptocurrency services. As part of its broader effort to crack down on tax evasion, the US Treasury Department also announced that it will require any cryptocurrency transfer worth $10,000 or more to be reported to the IRS.

The blockchain trilemma will make it impossible for cryptos to overcome ESG concerns, while the Crypto Impossibility Theorem will prevent cryptocurrencies from ever being stable stores of value.

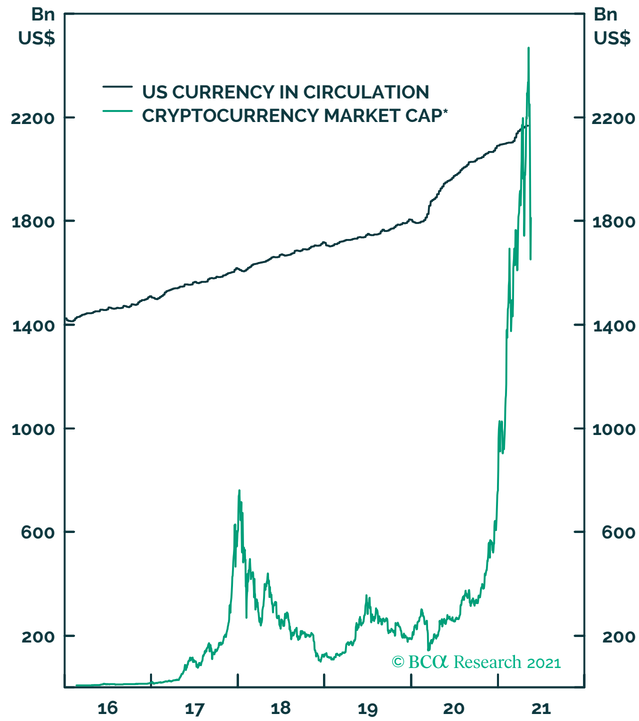
In the meantime, an ebbing of input price inflation will take some of the wind out of the sails from the argument that cryptos are an indispensable hedge against the "inevitable" debasement of fiat monies. **Chart 5** shows that DRAM prices have

CHART 5
To The Moon And Back?



* SOURCE: CME.
** STEEL REBAR FUTURES PRICE. SOURCE: SHANGHAI FUTURES EXCHANGE.
*** DRAMX DDR3 1GB 128Mx8 CHIP PRICE. SOURCE: DRAMEXCHANGE.
NOTE: DATA SHOWN AS PERCENT CHANGE SINCE BEGINNING OF 2021.

CHART 6
Aggregate Value Of Cryptos Briefly Surpassed The Entire Stock Of US Dollars In Circulation



* SOURCE: COIN DANCE.

rolled over. Lumber prices have dropped 11% so far this week. Corn, soybean, and steel prices have also backed off their highs.

Cryptos are like sharks; they need to move forward or they will sink. Back when they were unknown to most investors, a speculative case could have been made for buying cryptos. However, that case vanished earlier this year when the aggregate value of cryptocurrencies briefly surpassed the entire stock of US dollars in circulation (**Chart 6**). Even with the recent correction, there are 17 cryptocurrencies with market capitalizations above $10 billion (**Table 3**).

What will the ongoing crypto collapse mean for the broader investment landscape? In the near term, the pain in crypto markets could drag down other speculative assets such as tech stocks. In the long term, diminished investor interest in cryptos will benefit the stock market, as investor attention focuses back on equities.

For the broader economy, the impact of a crypto bear market will be limited. The banking system has very little exposure to cryptos. There will be a modest adverse wealth effect from falling crypto prices. However, the inability of a few laser-eyed crypto traders to buy their Lambos is hardly going to matter much against the backdrop of strong stimulus-fueled consumption growth in the US and a number of other economies.

The banking system has very little exposure to cryptos.

Investors should continue to overweight stocks in a global asset portfolio, favoring value over growth, cyclicals over defensives, and non-US stocks over their US peers.

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TABLE 3
Close To 20 Cryptos Have A Market Cap In Excess Of US$10bn

CRYPTOCURRENCIES WITH MARKET CAPS ABOVE $10 BILLION		
NAME	MARKET CAP (BN)	YTD CHANGE
Bitcoin	$751	37%
Ethereum	$324	283%
Binance Coin	$60	932%
Cardano	$58	935%
Tether	$58	0%
XRP	$55	398%
Dogecoin	$52	6,958%
Polkadot	$27	251%
Internet Computer	$21	-
Bitcoin Cash	$15	137%
Uniswap	$15	456%
USD Coin	$14	0%
Litecoin	$14	66%
Chainlink	$13	158%
Solana	$12	2,340%
Polygon	$12	10,643%
Stellar	$11	268%

SOURCE: COINMARKETCAP.

Global Investment Strategy View Matrix

	3-Month *MacroQuant** Tactical Recommendations	12-Month	10-Year
Global Asset Allocation			
Equities	5	4	3
Fixed Income	1	2	1
Cash	4	3	4
Global Equities (Region)**			
US	2	2	2
Euro Area	4	4	3
UK	2	4	3
Canada	4	4	3
Australia	5	4	3
Japan	2	4	3
EM	4	4	5
Global Fixed Income***			
Government	N/A	2	1
Investment Grade	N/A	3	3
High Yield	N/A	4	4
Duration	N/A	2	1
Inflation Protection	N/A	4	5
Global Fixed Income (Region)***			
US Treasuries	2	2	2
UK Gilts	4	3	2
German Bunds	2	3	3
JGBs	4	4	3
EM Sovereign	N/A	4	4
Currencies****			
USD	2	2	2
EUR	3	4	4
GBP	4	4	4
CHF	2	2	2
JPY	2	2	2
CAD	5	4	4
AUD	4	4	4
EM Currencies	N/A	4	4
Commodities (vs USD)			
Energy	5	4	3
Base/Bulk Metals	N/A	4	5
Gold	2	4	5
Softs	N/A	3	4

LEGEND:
1 – DENOTES STRONG UNDERWEIGHT/VERY BEARISH VIEW.
2 – DENOTES UNDERWEIGHT/BEARISH VIEW.
3 – DENOTES NEUTRAL VIEW.
4 – DENOTES OVERWEIGHT/BULLISH VIEW.
5 – DENOTES STRONG OVERWEIGHT/VERY BULLISH VIEW.
* THE LATEST *MACROQUANT* RECOMMENDATIONS AND A DISCUSSION OF THE *MACROQUANT* MODEL CAN BE FOUND HERE. TACTICAL RECOMMENDATIONS ARE SHOWN ONLY FOR ASSETS COVERED BY THE *MACROQUANT* MODEL.
** RELATIVE TO MSCI ACWI (CURRENCY UNHEDGED).
*** RELATIVE TO BLOOMBERG BARCLAYS GLOBAL AGGREGATE (CURRENCY HEDGED).
**** IN TRADE-WEIGHTED TERMS.

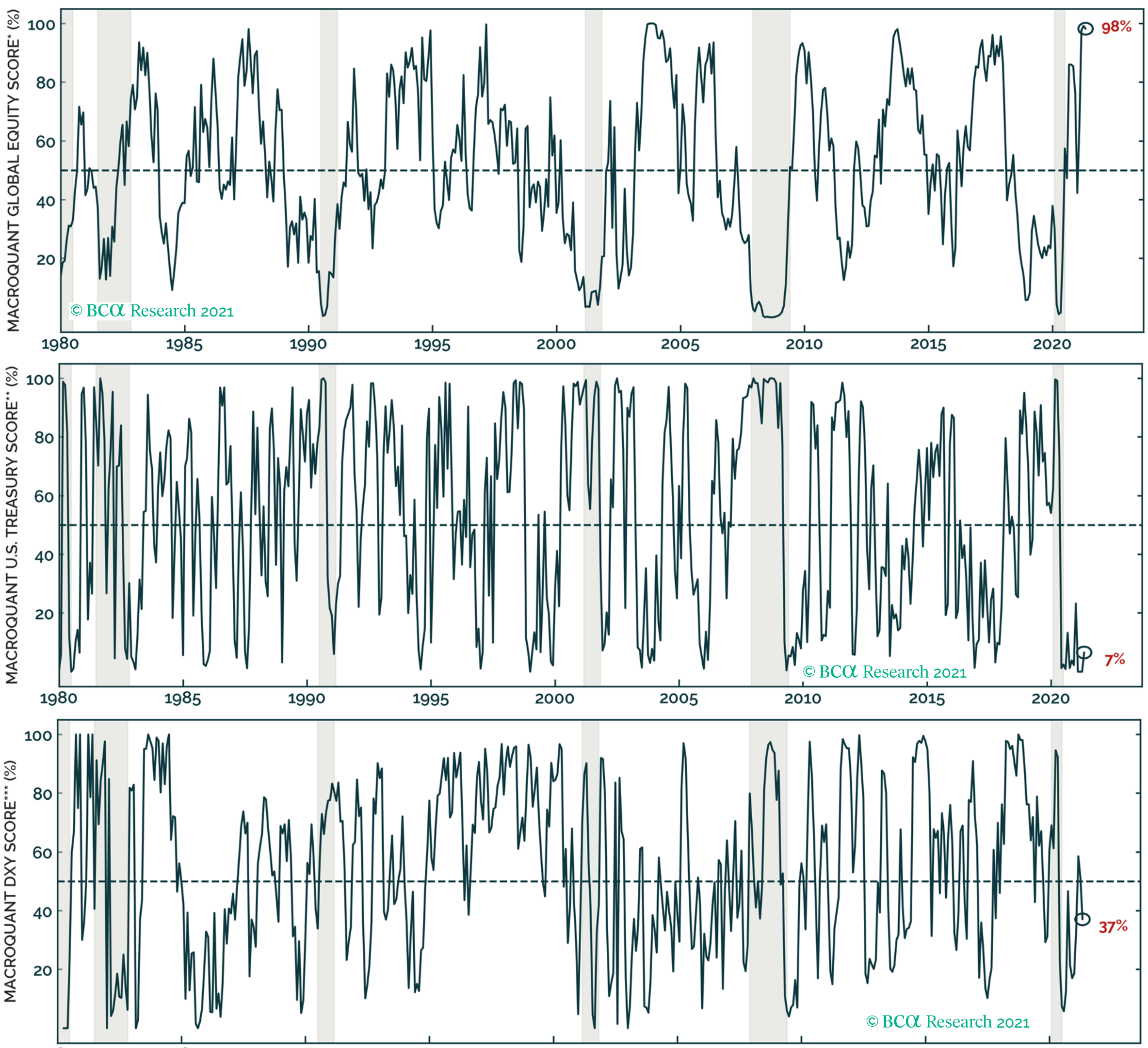
Special Trade Recommendations

This table provides trade recommendations that may not be adequately represented in the matrix on the preceding page.

Trade	Inception Level	Initiation Date	Return-To-Date*	Stop Loss	Comments
Short Bitcoin**	$49,185	May 13/2021	21.1%	$65,000	Special Shorting Technique**
Long MSCI Value/MSCI Growth	100	Dec 10/2020	9.5%	-5%	
Long MSCI Banks/MSCI All-Country-World Index	100	Dec 10/2020	14.7%	-5%	

* THE MARK-TO-MARKET CALCULATIONS ARE BASED ON THE CLOSE OF EVERY WEDNESDAY, AND THE MARKET PRICE OF BITCOIN AT 4PM (EDT) THURSDAY.
** THE PERFORMANCE OF THE SHORT BITCOIN TRADE IS MEASURED USING A SHORTING TECHNIQUE DESCRIBED IN THE GLOBAL INVESTMENT STRATEGY REPORT TITLED "HOW TO SHORT BITCOIN, OR ANYTHING ELSE, WITHOUT LOSING YOUR SHORTS," DATED APRIL 30, 2021.

Current *MacroQuant* Model Scores



* THE *MACROQUANT* GLOBAL EQUITY SCORE IS A MARKET-WEIGHTED SUM OF ALL *MACROQUANT* REGIONAL EQUITY SCORES.
** THE *MACROQUANT* BOND MODEL IS BASED ON 76 BUSINESS CYCLE, MONETARY/FINANCIAL, SENTIMENT/TECHNICAL, AND VALUATION METRICS.
*** THE *MACROQUANT* DXY MODEL COMPUTES THE DXY SCORE BASED ON THE DEVIATION OF THE DXY FROM ITS FAIR VALUE AND VARIOUS SENTIMENT AND TECHNICAL VARIABLES, INCLUDING MOMENTUM, FUND FLOWS, AND POSITIONING.
NOTE: SHADED AREAS REPRESENT NBER-DESIGNATED RECESSIONS.
SOURCE: *MACROQUANT* VERSION 2.0.
FOR MORE INFORMATION ON THE *MACROQUANT* MODEL PLEASE REFER TO: GLOBAL INVESTMENT STRATEGY TACTICAL GLOBAL ASSET ALLOCATION MONTHLY UPDATE BASED ON BCA RESEARCH'S MACROQUANT MODEL.

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