Economics of Cryptocurrencies

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This presentation is based on

- Liu and Tsyvinski "Risks and Returns of Cryptocurrency", *The Review of Financial Studies*, 2020

- Liu, Tsyvinski, Wu "Risks and Returns of Cryptocurrency", *The Journal of Finance*, 2020 *conditionally accepted*

- *and other ongoing work*

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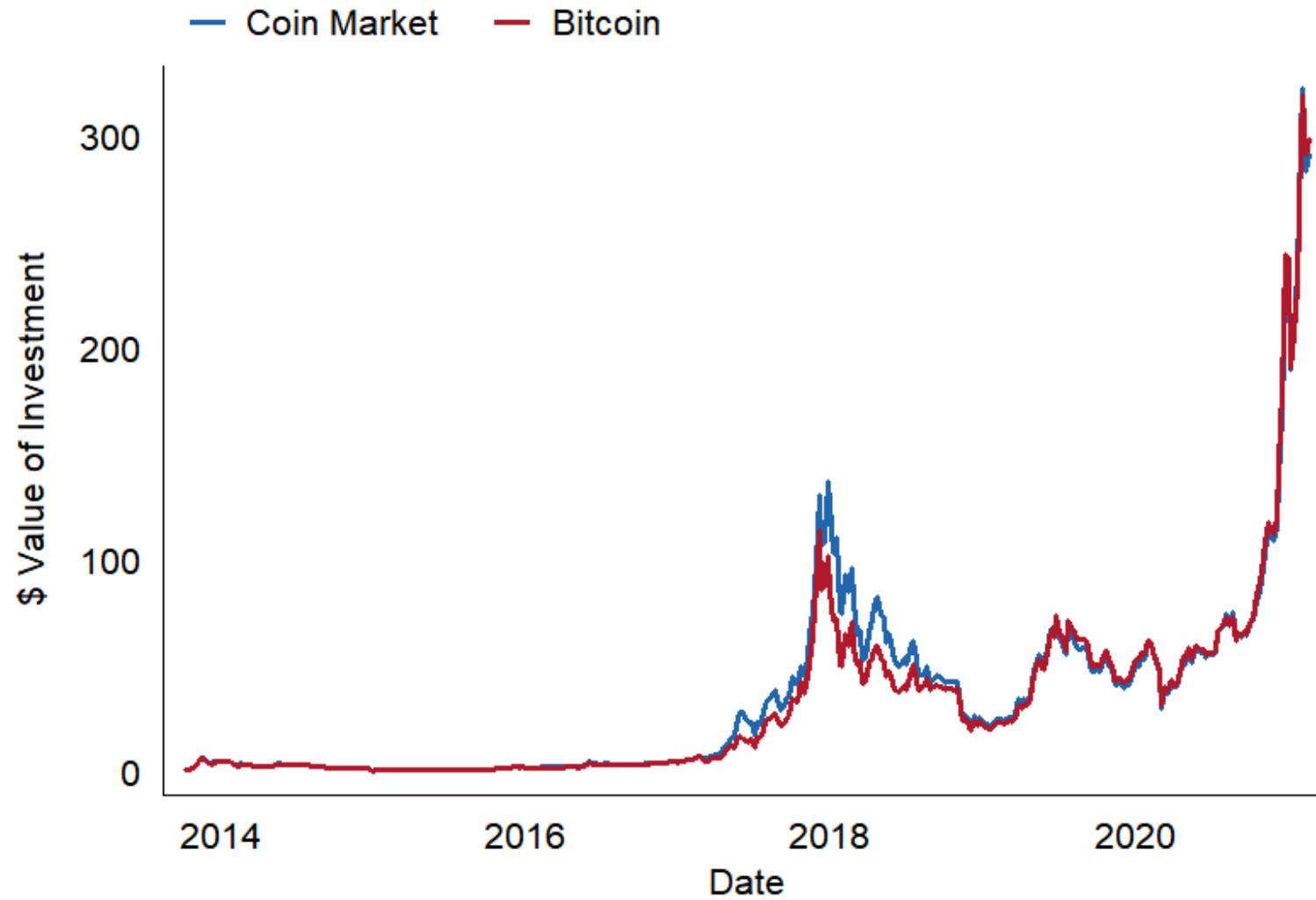University of California, Berkeley

Main idea

- Understand cryptocurrencies from the point of view of asset pricing

- Disclaimer: do not take anything here as an investment advice

First ... lets create an index: CMKT

- 1800 currencies – coin market (CMKT):
  - Value weighted
- Capitalization >1 mln. USD
- Data:
  - Quality mostly good but need to vet carefully

Some basic statistical properties since 2014 – weekly

- **Mean return**: 2.25%
  - Stocks: 0.23%

- **Volatility**: 12.89% standard deviation
  - Stocks: 2.11%

- **Sharpe ratio**: return/volatility: 0.17 (yearly: 1.26)
  - Stocks: 0.11 (0.79)

Fact #1:

- Crypto has an order of magnitude higher returns and is an order of magnitude more volatile than stocks
  - but has a broadly similar Sharpe ratio

Is crypto:

- "**currency**"?
- "**digital gold**" or a "**commodity**"?
- a "**bet on future technology**"?
- an "**inflation/macro hedge**"?

Currency?

- Exposure to returns of
  - Australian dollar,
  - Canadian dollar,
  - Euro,
  - Singaporean dollar,
  - U.K. pound
- Exposures to currency factors
  - as Lustig, Roussanov, and Verdelhan (2011)
- **Answer**:
  - no statistically significant exposure

Commodities?

- Exposure to returns of:
  - gold,
  - platinum,
  - silver

- Answer:
  - <u>no statistically significant exposure to precious metal commodities</u>

A bet on the future of technology?

- Exposure to the **equity risk factors**:
  - Capital Asset Pricing Model (CAPM),
  - Fama-French three-factor,
  - Carhart four-factor,
  - Fama-French five-factor and six-factor models.
  - <u>No statistically significant exposure to the known factors</u>
- Exposure to the "**factor zoo**"
  - factors for predicting the cross-section of stock returns (Feng, Giglio, and Xiu 2017 and Chen and Velikov 2017)
  - the loadings of the **155 factors**
  - <u>No evidence of systematic exposure</u>

"Macro hedge?"

- Exposure to **macro factors**:
  - nondurable consumption growth,
  - durable consumption growth,
  - industrial production growth,
  - personal income growth
  - No statistically significant evidence of exposure
- **Inflation and inflation expectations**?
  - No statistical evidence of exposures to either inflation or inflation expectations (level/growth)

Fact #2

- Crypto is driven by different factors than standard assets

But then …

- It is great for diversification

- Should hold at least some in your portfolio

- More precisely:
  - **Black-Litterman** – how much should a risk-neutral investor with different views hold

Wait a second …

- Random noise is also uncorrelated
- Is crypto just noise?

Theory: Network factors

- Cong, Li, and Wang 2019; Sockin and Xiong 2019; Pagnotta and Buraschi 2018; Biais et al. 2018

- Main idea:
  - more users $\rightarrow$ higher value of the "network" (similar to, for example, social networks)

- Can also think as a "measure of value or utility"

Testing network factors:

- Construct:
  - number of wallet users,
  - number of active addresses,
  - number of transaction counts,
  - number of payment counts (and many others)
- Coin market (CMKT) returns:
  - <u>Positively correlate</u> with network factors
- Also, <u>dynamically</u>:
  - Crypto prices are forward looking and contain info about future network adoptions
  - <u>High coin market returns predict higher future # of users</u>

Theory: production factors

- Theory
  - Sockin and Xiong 2019; Abadi and Brunnermeier 2018; Cong, He, and Li 2018
- Costs of mining are important drivers of prices
- Crypto mining = Computing power * Electricity

Tests:

- Proxy for **electricity costs**:
  - electricity prices and generation in USA, China, Sichuan (largest mining farm)
- Proxy for **computing power**:
  - prices of Bitmain Antminer, stock prices of NVIDIA, AMD, Taiwan Semiconductor Manufacturing Company, etc. – specialized chip manufacturers
- Other tests:
  - Proxy the **profitability of miners** (theory: Easley, O'Hara, and Basu 2019)
- Answer:
  - no evidence of production factors playing a significant role

Fact 3: Crypto prices are driven by demand (utility) considerations but not by supply (production) considerations

Are cryptocurrency returns predictable?

- Specifically:
  - do they behave similar to other asset classes in terms of their "crypto characteristics"

What predicts returns: crypto momentum

- One of the most studied asset pricing regularities is momentum
  - (e.g., Jegadeesh and Titman 1993; Moskowitz and Grinblatt 1999).
- Theory:
  - Cong, Li, and Wang (2019)
  - the network effect of user adoption generates a positive externality that is not immediately incorporated into cryptocurrency prices → momentum
- We find:
  - Strong statistical evidence of momentum at different horizons

What predicts returns: crypto investor attention

- Theory:
  - Sockin and Xiong (2019) differentiate positive investor attention and negative investor attention

- Construct:
  - Proxies for attention: Google searches, Twitter searches, etc.

- We find:
  - Strong evidence for both positive and negative attention
  - And that attention and momentum are distinct

What does not work: crypto valuation ratios

- Equity market:
  - the fundamental-to- market ratios (e.g., dividend-to-price; earnings-to-price).
- Crypto market:
  - <u>Very weak evidence for fundamental to price ratios can predict returns</u>

Fact #5: Crypto market returns can be predicted by crypto momentum and crypto investor attention

Other interesting facts

Regulations

- Auer and Claessens (2018) and Shanaev et al. (2019) determine 120 regulative events

- We find:
  - <u>cryptocurrency returns respond to negative regulative events but not to positive regulative events</u>

Speculative interest

- Construct speculative shares controlling for network growth
- <u>Find no statistical evidence of either contemporaneous effects of predictability</u>
- But <u>high returns today predict future speculative share</u>

Sentiment

- Construct a measure that is directly aimed to capture investor crypto sentiment
- <u>Sentiment measure positively and significantly predicts future cryptocurrency returns.</u>
  - is distinct from the investor attention and cryptocurrency momentum results

Beauty contest

- Use Biais and Bossaerts (1998) to measure crypto disagreement:
  - Volume to volatility ratio

- Coin market returns are higher when there is a lot of disagreement
  - But does not predict future returns

So far …

- Considered coin market
- But what determines the prices of individual coins?

Systematic approach

- Create an equivalent of the "factor zoo" for crypto
    - Size
    - Momentum
    - Value
    - Volume
    - Volatility
    - Liquidity
- We find:
    - ten cross-sectional cryptocurrency return predictors "strategies"

A three factor model

- Return on a coin =
  - Return on the coin market factor (CMKT)
  - Return on the coin market factor (CMOM)
  - Return on coin market size (CSMB)
- Similar in spirit to the factor models in equity markets:
  - <u>Small number of factors (three) "span" or explain the all of the return predictors</u>

Fact #6: a small number of factors explain the cross section of the coin returns

Size: investigating the mechanism

Size premium is a **proxy for liquidity**:

1. Small coins have lower prices and higher Amihud illiquidity measure relative to the large coins;

2. In the time-series, the cryptocurrency size premium is larger at times of high cryptocurrency market volatility.

3. In the cross-section, the cryptocurrency size premium is more pronounced among coins that have high arbitrage costs;
   - Create a composite index for the "cost of arbitrage"
   - Small coins are more difficult to arbitrage (cf. Shleifer and Vishny (1997) and Pontiff (2006)

- But interestingly: the size effect does not capture the lottery or skewness effect among the very small coins.

Size: capital gain versus convenience yield

- Theory: Cong, Li, and Wang 2018; Sockin and Xiong 2018; Prat, Danos, and Marcassa 2019
  - Two benefits for investors: capital gain and the convenience from transactions
  - Larger and more mature cryptocurrencies have higher convenience yield, and thus their capital gain should be lower.
- We find:
  - Cryptocurrency size premium is relatively large at times of high demand for transactions.
  - Interestingly: momentum is not

Momentum: theory

- The behavioral explanations of the momentum (e.g., Barberis, Shleifer, and Vishny 1998; Daniel, Hirshleifer, and Subrahmanyam 1998; Hong and Stein 1999)

Momentum phenomenon could arise as a result of:

1. Investors' delayed reaction to information (underreaction)
2. Overreaction to information (then should be followed by reversal)

Momentum: Underreaction to information? No!

- Underreaction:
  - Information should be slower to incorporate for the small coins
- We find that momentum is larger among large coins
  - Where information quality and its incorporation is better
  - Does not support underreaction
- In contrast to equity,
  - where momentum strategies work better among smaller stocks (see Hong, Lim, and Stein 2000).

Momentum: Overreaction?
Yes!

- Strong at relatively shorter horizons

- Has a peak
  - → after the peak have negative returns

- Strong among high-attention coins
  - Consistent with recent theories of investor overreaction (Peng and Xiong 2006; Andrei and Hasler 2015)

Fact 6: Cross-sectional factors connect to theories in other asset classes

Fact #7: It is not just currencies

Comparison Between Digital Network Index and Coin Market Index
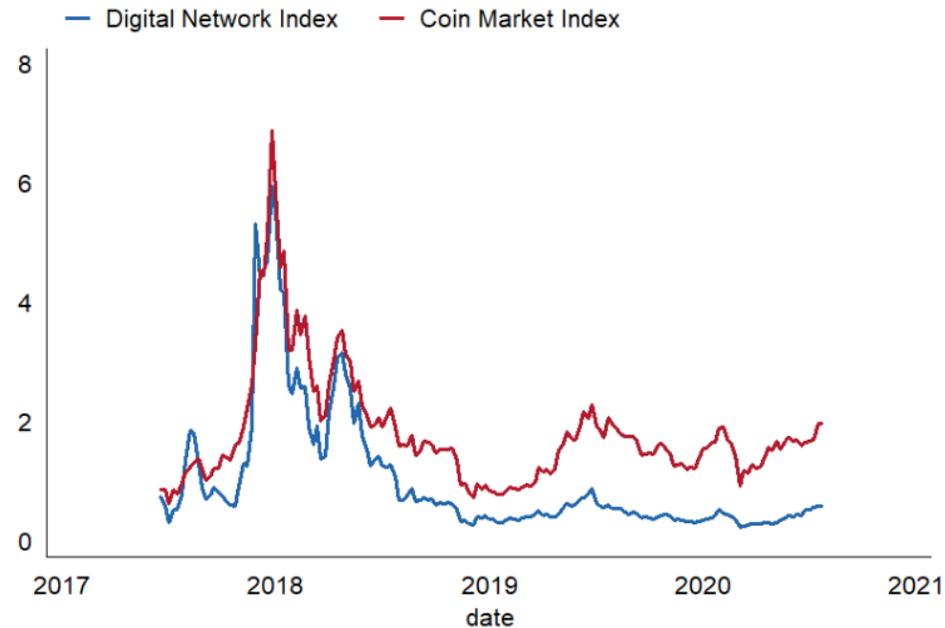
Main takeaways

- Crypto is "coming of age"
- Can be analyzed with the standard asset pricing tools
- Exciting area of research