A Model of the Optimal Selection of Crypto Assets

Silvia Bartolucci & Andrei Kirilenko
Some definitions

A *crypto asset* is an intangible digital asset whose issuance, sale or transfer are secured by cryptography and shared electronically via a distributed ledger.

A *distributed ledger* (blockchain) is a database of issuance and transaction records.

Each crypto asset has its own blockchain supported by its own network of nodes.
An intangible digital asset, but not a liability

A crypto asset is an intangible digital asset as it is

without physical substance (intangible),

but is digitally-identifiable (digital)

and held in expectation of future economic benefits (asset).

Under the current standards, a crypto asset does not meet the definition of either cash or a financial instrument because it does not represent a claim or contractual relationship that results in a monetary or financial \textit{liability} on any identifiable entity.
Many assets

THE CRYPTO ASSETS MAP

Top 100 and Market Cap as of 30/September/2017

The Crypto Assets Map groups blockchain-based assets in three key value vectors: Currency, Platform and Vertical application. More detailed clusters within each vector are represented as separate circles, which display the relative market cap of the cluster and the assets that belong to them. As per CoinMarketCap, the total market cap at the date above was $147,188,434,405. The Top 100 represented 98% of this total.

Platforms

Provide infra-structure for other projects and power transactions. 19 assets representing 20% of market cap.

Currencies

Are stores of value and medium for transactions. 30 assets representing 63% of market cap.

Verticals

Have a specific application within an industry or use case. 51 assets representing 11% of market cap.

LICENSED UNDER A CREATIVE COMMONS ATTRIBUTION-NOTICE-PERMISSIONS 4.0 INTERNATIONAL (CC BY-NC-ND 4.0) LICENSE.

Disclaimers: The Crypto Assets Map is not investment advice and is intended for informative purposes only. The information is provided as is, without any guarantee about its correctness nor its adequacy to make investment decisions. All trademarks / logos are copyright material of the respective organisations and used only as visual aid.
Many features, protocols and uses

Core Infrastructure
- Security
  - Rivetz
  - Zebl
  - Val:ID
  - Sapien
  - Sentinel Protocol
- Cloud
  - SONM
  - Sonix
  - Ochain
  - Dadi
  - Filecoin
  - Bluzelle
  - Storj
- Core Tech
  - Elastos
  - Quantstamp
  - Wanchain
  - COMSA
  - Tezos
  - Telegram
  - EOS
  - Polkadot
- Cryptocurrencies
  - AppCoins
  - Telcoin
  - Credits
  - Cred
  - Environ
  - Electroneum
  - STK

Financial Services
- Finance: Investments
  - SPiCE Venture Capital
  - Savedroid
  - Covesting
  - Bloom
  - Enigma
  - FinShi Capital
  - Cyberep
  - GBX
  - Crypt20
- Finance: Markets
  - Bankex
  - Quoine
  - Naga
  - We Power
  - Bancor
  - Kyber Network
  - ZEN
  - Celsius
  - Comsa
  - Olympus Labs
- Finance: Banking & Payments
  - Salt
  - Finom
  - Crypterium
  - Bnkera
  - Celsius
  - Flashmoni
  - TenX

Vertical Apps
- Media & Social
  - Status
  - Zeepin
  - OnLive
  - Singularitynet
  - Tamatu
  - MobileGo
  - Play2Live
  - Referre
  - Unik
  - Reality Clash
  - Decentraland
  - Boatpilot
  - Litra Coin
  - Thor
  - Solve Care
  - Mobotic
  - Medicalchain
  - Selfkey
  - Civic
  - Databroker Dao
  - Nucleus Vision
  - Sirin Labs
Successful adoption of crypto assets hinges on network effects.

Varian (2017): “[A] good exhibits network effects if the value to a new user from adopting the good is increasing in the number of users who have already adopted it.

This generates a positive feedback loop: the more users who adopt the good, the more valuable it becomes to potential adopters. This positive feedback loop also works in reverse: if adoption fails to reach a critical mass of users, the good or service may fall into a “death spiral” and ultimately disappear.”

The majority of crypto assets will become worthless.

Some could end up being adopted widely enough to ensure their survival.

A very small number of them could become preferred assets to store and transfer wealth to the future.
Network effects come from demand side

Network effects are a demand-side rather than a supply-side, transactions costs or learning phenomena.

Varian (2017): “Network effects are due to value increasing with the number of units sold, while increasing returns to scale have to do with the cost declining or the quality improving with the number of units produced.”

Buterin (2014): “Network effects are actually split up into several categories: blockchain-specific network effects, platform-specific network effects, currency-specific network effects, and general network effects.”
How are investors going to be making selection decisions over many available crypto assets?

Possibilities:
A. Same as over the existing (not digitally-native) assets – stocks, bonds, derivatives, commodities.
B. Differently.

Which features of these intangible digital assets would drive investment (demand) choices?

Possibilities:
A. Same as for the existing (not digitally-native) assets, e.g., correlation with future consumption.
B. Plus or only digitally-native asset features.

Which types of (supplied) assets will survive and which will go extinct?

Possibilities:
A. Same as for the existing (not digitally-native) assets, e.g., how well is an investment governed.
B. Plus or only digitally-native governance features.
We propose a unifying framework where crypto assets can be classified according to two main intrinsic features:

**Security**: technological vulnerability to risks of fraud, manipulation, abuse, and attack.

**Stability**: vulnerability to risks related to potentially faulty governance.

Security is a *cross-sectional* attribute of a crypto asset. It reflects its ability to retain value relative to other crypto assets at a point in time.

Stability is a *time series* attribute of a crypto asset that reflects its ability to retain value across time for a given level of security.
Security: technological vulnerability to risks of fraud, manipulation, abuse, and attack.

Security is a cross-sectional attribute of a crypto asset. It reflects its ability to retain value relative to other crypto assets at a point in time.

Stability: vulnerability to risks related to potentially faulty governance.

Stability is a time series attribute of a crypto asset that reflects its ability to retain value across time for a given level of security.
Security: technological vulnerability to risks of fraud, manipulation, abuse, and attack.

Security is a *cross-sectional* attribute of a crypto asset. It reflects its ability to retain value relative to other crypto assets at a point in time.

Stability: vulnerability to risks related to potentially faulty governance.

Stability is a *time series* attribute of a crypto asset that reflects its ability to retain value across time for a given level of security.
Our framework: Demand for crypto assets

- The demand for and adoption of crypto assets is inherently different from that of standard financial assets due to *low frictions*.

- We assume that investors “interact” with crypto assets over a digital platform: the **crypto app**.

- The crypto app:
  - Stores info about available crypto assets.
  - Collects data about users’ adoption preferences and the global market state.
  - Provides investors-specific recommendations.
Our framework: Demand for crypto assets

* The demand for and adoption of crypto assets is inherently different from that of standard financial assets due to low frictions.

* We assume that investors “interact” with crypto assets over a digital platform: the crypto app.

The crypto app:

* Stores info about available crypto assets.
* Collects data about users’ adoption preferences and the global market state.
* Provides investors-specific recommendations.

We simulate investors-app interactions and monitor the outcome in terms of assets’ adoptions \([a]\) and expected returns \([r]\).
Our framework: Demand for crypto assets

- The demand for and adoption of crypto assets is inherently different from that of standard financial assets due to low frictions.

- We assume that investors “interact” with crypto assets over a digital platform: the crypto app.

- The crypto app:
  - Stores info about available crypto assets.
  - Collects data about users’ adoption preferences and the global market state.
  - Provides investors-specific recommendations.

We simulate investors-app interactions and monitor the outcome in terms of assets’ adoptions \([a]\) and expected returns \([r]\).
The crypto app: Cinder?

**Supply**
- N assets
- Assets features
  \[ f_i = [s_i, \xi_i] \]

**Crypto App**
- \([f]\) Assets features
- \([r]\) Local variables
- \([a]\) Global variables

\[ P_{i,j}(R_{tot}, f, \beta) \]

**Demand**
- K assets pairs
- K investors
  - \(\beta\): risk settings

**Proposed change**
- k-th investor

**Recommendation 1**
- Accept
  - Update state

**Recommendation K**
- Reject

\([r']\)
\([a']\)
\([\Gamma']\)
Expected returns and adoption

* Crypto assets generation and initialisation of adoption and returns
  
  Features $s_i, \xi_i, i = 1, \ldots, N$
  
  Global quantity $R_{tot}(t) = \sum_{i=1}^{N} a_i(t) r_i(t)$

* Each investor compares two assets and proposes a change in adoption

  $a_i(t + 1) = \max(a_i(t) - \delta, 0)$  \hspace{1cm} \text{Decrease adoption}$
  
  $a_j(t + 1) = \min(a_j(t) + \delta, 1)$  \hspace{1cm} \text{Increase adoption}$

* The app calculates the probability of accepting the change based on the (i) assets’ essential features, (ii) information about the adoption choices of all other investors, and (iii) expected future economic benefits of adoption

$$P(a_i \rightarrow \tilde{a}_i, a_j \rightarrow \tilde{a}_j) = \frac{1}{(1 + e^{\beta_0 \Delta R_{tot}})(1 + e^{\beta_1 \Delta s})(1 + e^{\beta_2 \Delta \xi})}$$

A choice between security, stability, and total returns given preference (beta parameters). Beta-parameters represent the investors’ attitudes towards both the global state of the system and asset-specific features.
Expected returns and adoption

* **Updating the expected returns**

\[ r_i(t) = r_i(t - 1) + \Delta a_i(t) + \eta_i(t) \quad \text{with} \quad \eta \sim \mathcal{N}(0, f(\xi)) \]

* **Optimal recommendations per asset class \( \kappa \) to minimise expected returns volatility**

\[
\min_{a_i, r_i, i \in \kappa} \sqrt{(a_i - \bar{a}^*)^2 + (r_i - \bar{r}^*)^2}
\]

\[ \text{s.t.} \sum_{i \in \kappa} r_i a_i \geq \sum_{i \in \kappa} r_i^* a_i^* \]

Minimise the distances of each asset from the “centre of mass” of their respective clusters in the adoption-return space

Maximise the total expected return of each sub-class
Expected returns and adoption
Simulations

\[ \beta_0 = \beta_1 = \beta_2 = 1 \]
Expected returns and adoption dynamics

\[ \beta_0 = \beta_1 = \beta_2 = 1 \]

![Graphs showing expected returns and probability of not being adopted](image-url)
Changing investors’ preferences

Probability distribution of the average adoption per asset class

\[ \beta_1 \]

\[ \beta_2 \]

- CBDC
- SC
- CC
- CT

High adoption

Low adoption
A different composition of the crypto-ecosystem (e.g. number of assets per class) may affect investment decisions.

We can show that changes in the composition of the crypto-market can be rebalanced by modifying the investors’ $\beta$ parameters.
Introducing misaligned investors with opposite strategies determines a non-trivial behaviour in the system together with the emergence of new stable configurations, but may also destabilise the system.
Summary

* Investors interact with crypto assets over a crypto app providing optimal adoption recommendations.

* We characterise the dynamics of crypto assets adoption and observe the emergence of *multiple stable configurations*.

* The *composition of the ecosystem* affects investors’ decisions and final optimal configurations.

* *Heterogeneous investors*: disseminating contrasting views, which may affect investors’ opinions on the assets and the associated risks, may destabilise the ecosystem.
Thank you!

A Model of the Optimal Selection of Crypto Assets