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Editorial: Cryptocurrency Transaction Analysis From a Network Perspective

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Editorial on the Research Topic

Cryptocurrency Transaction Analysis From a Network Perspective

The past 2 years have seen a surge of research articles themed on cryptocurrency analytics [1]. We are glad that our research topic, Cryptocurrency Transaction Analysis from a Network Perspective, which consists of nine novel contributions, can join this exciting trend and has already drawn attention from academia and industry.

There are two common data sources available for cryptocurrency analytics. The first is blockchain data. Public blockchains, such as Bitcoin and Ethereum, store transactions transparently in an open database. With a bit of effort unpacking the transactions from a compact storage format, one can readily use network science methods and machine learning tools to mine for knowledge, be it regulatory intelligence or market signal. The second is market information. The quotation ticks and trading volumes of the 10,000 + cryptocurrencies and tokens traded in many centralized and decentralized exchanges are curated by market monitoring sites like coinmarketcap. These data enable insightful research of the cryptocurrency market's risk and potential market manipulation activities. Articles in our research topic cover both lines of work with significant findings.

A fundamental property of cryptocurrency systems' public-key-private-key design is that the pseudonyms, i.e., blockchain addresses, recorded in the database cannot be associated with any physical identity, such as an IP address or email address. However, various heuristic algorithms have been proposed to "link" addresses together, that is, to associate multiple blockchain addresses to the same holder. Fischer et al. integrated a spectrum of address-linking algorithms and used a network-based clustering method to synthesize a new method that can reliably associate the addresses.

Another fundamental property of blockchain data is traceability, i.e., one can trace the genuine money flow through a chain of addresses. Naturally, crypto services that deliberately obfuscate such traceability, also known as mixing services, have been created for laundering (often illicit) money. Liu et al. proposed a conceptual modeling framework to analyze the different roles of blockchain addresses in the bitcoin mixing services. Their model helped find and characterize the organizer, soldiers, and communicators in a money laundering case study.

The cryptocurrency transactions can be viewed as a complex network in which the blockchain addresses are the nodes, and the money flow in the transactions are the edges linking the nodes. As a constantly expanding network, physicists are interested in the underlying mechanism of its growth. Preferential attachment [2] is one of the most prominent governing growth mechanisms of many natural and man-made complex networks, as well as bitcoin [3]. Collibus et al. showed that Ethereum and its most market-capitalized ERC-20 token habitants Binance, USDT, and Chainlink also obey such law, but with a super-linear variance.

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From a machine learning perspective, the network structure of transaction data helps construct rich features for downstream tasks, such as inferring the identities of blockchain addresses. Lin et al. constructed a transaction network from Ethereum transactions with temporal and weighted edges to capture the network topology evolution. By applying graph embedding algorithms on this dynamic network, they are able to recognize labeled phishing addresses from others.

The article that attracted the most attention (more than 25 k online views) as of February 2022 is Jiang and Liu's analysis of the CryptoKitties game's transaction history. They characterized the evolution of the transaction network and proposed several reasons why the game gained sudden attention from players but also collapsed quickly, just within 1 month. Their suggestions to blockchain game design may shed light on the current development of the non-fungible token (NFT) industry.

Volatility is a rate that describes the price change of an asset over a particular period. It is a fundamental indicator guiding cryptocurrency investments. Can volatility be predicted from market signals? The answer is positive and definite. Barjašić and Antulov-Fantulin found that bitcoin-related tweets, bitcoin trade volume, and bid-ask spread can be incorporated into generalized autoregressive conditional heteroscedasticity (GARCH) models to predict volatility.

If two assets are affected by similar market factors, they may experience a synchronized price trend or volatility level. The latter case is also called volatility connectedness or volatility spillover. The current global cryptocurrency market is still in its early development. One crypto asset can be traded in multiple exchanges, and each exchange may have different asset listings and price momentum. The intertwined market is indeed highly interconnected, volatility-wise. Chen and Dong's analysis of six bitcoin-fiat money pairs and Li et al. examination of seven major cryptocurrencies all found volatility spillover effects. Liu and Liu found that if two crypto projects share the same investors or similar market embeddedness, as measured by the structural properties in a co-investment network, they may also share similar market performance, including volatility and others. The strong spillover effects imply the ineffectiveness of the cryptocurrency market.

We believe that the research on cryptocurrencies will continue to prosper in the coming years as the market develops. We hope that the series of articles that we have collected here can serve as a bedrock for the future development of cryptocurrency analytics. Finally, we would like to take this chance and thank all the authors and reviewers for your contribution. We also refer the readers to some sister issues in Frontiers in Blockchain: Blockchain Through the Lens of Network Science and Non-Financial Applications of Blockchains: Systematizing the Knowledge that address similar research topics.

AUTHOR CONTRIBUTIONS

XFL wrote the editorial, CGA, Z-YZ, and J-GL edited.

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