Pairwise and high-order dependencies in the cryptocurrency trading network

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In this work we analyse the effects of information flows in cryptocurrency markets. We first define a cryptocurrency trading network, i.e. the network made using cryptocurrencies as nodes and the Granger causality among their weekly log returns as links, later we analyse its evolution over time. In particular, with reference to years 2020 and 2021, we study the logarithmic US dollar price returns of the cryptocurrency trading network using both pairwise and high-order statistical dependencies, quantified by Granger causality and O-information, respectively. With reference to the former, we find that it shows peaks in correspondence of important events, like e.g., Covid-19 pandemic turbulence or occasional sudden prices rise. The corresponding network structure is rather stable, across weekly time windows in the period considered and the coins are the most influential nodes in the network. In the pairwise description of the network, stable coins seem to play a marginal role whereas, turning high-order dependencies, they appear in the highest number of synergistic information circuits, thus proving that they play a major role for high order effects. With reference to redundancy and synergy with the time evolution of the total transactions in US dollars, we find that their large volume in the first semester of 2021 seems to have triggered a transition in the cryptocurrency network toward a more complex dynamical landscape. Our results show that pairwise and high-order descriptions of complex financial systems provide complementary information for cryptocurrency analysis.

References

[1] T. Scagliarini, G. Pappalardo, A.E. Biondo, A. Pluchino, A. Rapisarda, S. Stramaglia. Pairwise and high order dependencies in the cryptocurrency trading network. Sci. Rep. 12, 18483 (2022) .