

A Network Approach to the study of the Bitcoin Price Evolution

A. Bove¹, C. Campajola², F. Mottes³, V. Restocchi⁴, N. Vallarano⁵, T. Squartin⁵, C. J. Tessone⁶

(1) ICTEAM, Université Catholique de Louvain, B-1348 Louvain-la-Neuve (Belgium)

(2) Scuola Normale Superiore, I-56126 Pisa (Italy), carlo.campajola@sns.it

(3) Physics Department, Università di Torino, I-10125 Torino (Italy) and INFN

(4) The University of Edinburgh, EH89YL Edinburgh (UK)

(5) IMT School for Advanced Studies, I-55100 Lucca (Italy)

(6) URPP Social Networks, University of Zurich, CH-8050 Zurich (Switzerland)

The functioning of the cryptocurrency Bitcoin relies on the open availability of the entire history of its transactions. From the point of view of network science, this makes it a particularly interesting socio-economic system to analyse. In this paper we consider the complete Bitcoin transaction history from January 9th 2009 to December 18th 2017 and study the evolution of four different network representations, combining two choices of time aggregation – daily and weekly – and two choices of node aggregation – single addresses and single users, which we identify through specific heuristic algorithms. By focusing on the local connectivity patterns of these networks we provide evidence that structural changes correlate with Bitcoin price variations and explore multiple kinds of Granger causality relationships between the two.

Interestingly we find evidence of significant changes in the local structure of the network impacting on the price evolution. We observe that the heterogeneity of the nodes selling activity, tracked by the higher moments of the out-degree distribution, is correlated with negative price returns, and the same quantities are found to Granger-cause price increases on the weekly time-scale and sharp crashes on the daily time-scale. The associated narrative, summarized in Figure 1, is that public interest generated by positive returns causes an increase in the number of active users on the weekly time-scale, which in turn introduces more heterogeneity as newcomers typically buy and hold their Bitcoins from exchanges that become increasingly trafficked. This mechanism is self-reinforcing since a steady inflow of capital will cause the price to rise further, until at some point speculators realize their profit selling their positions. Indeed we find a causal relation running from sharp increases – beyond the 90th percentile – of out-degree heterogeneity to price crashes – negative returns in the 10% tail.

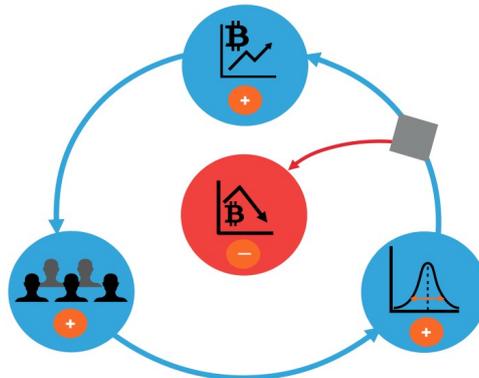


Figure 1: Granger causality chains in the Bitcoin economy – outside loop happens on a slow, weekly time-scale, which then breaks with an extreme price drop on the daily time-scale.

We find this mechanism to be particularly present in the early stage of the Bitcoin economy, while after 2014 the system stabilizes and price movements become less predictable from local network observables.

Our analysis not only confirms that abnormal increases in the number of active users can be a predictor of unsustainable positive price trends that will eventually culminate in a crash, as suggested by Wheatley et al., but shows that a closer look at the local structure of the Bitcoin economy can augment our understanding on what sorts of behavioral trends cause instabilities in the market.

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References

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