

Online Appendix

On the Evolution of Cryptocurrency Market Efficiency

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Abstract: This note provides an additional empirical result for Noda (2020). In particular, we employ new daily data that includes the period after the onset of the COVID-19 pandemic and estimate a time-varying degree of market efficiency in order to investigate the impact of the incident on the cryptocurrency markets. We find that the COVID-19 pandemic hardly affects cryptocurrency market efficiency.

Keywords: Efficient Market Hypothesis; Adaptive Market Hypothesis; GLS-Based Time-Varying Model Approach; Degree of Market Efficiency; COVID-19 Pandemic

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A.1 The COVID-19 Pandemic

On January 30, 2020, the World Health Organization (WHO) declared the outbreak of coronavirus disease 2019 (COVID-19) a Public Health Emergency of International Concern (PHEIC). Thereafter, on March 11, 2020, Tedros Adhanom, Director-General of WHO, characterized COVID-19 as a pandemic. Henceforth, we refer to this incident as the COVID-19 pandemic. It is widely known that the COVID-19 pandemic has been having a fairly serious effect on the global financial markets. In particular, the COVID-19 pandemic has affected the cryptocurrency markets: the price of Bitcoin declined about USD 5,000 in the past month. We investigate here the impact of the COVID-19 pandemic for cryptocurrency market efficiency in the sense of Fama (1970) using Ito et al.’s (2014; 2016; 2017) GLS-based time-varying AR model.

A.2 Cryptocurrency Market Efficiency

In the main text, we conclude that Lo’s (2004) is supported in the cryptocurrency markets (Bitcoin and Ethereum). Note that the dates of the dataset used in the main text extend up to September 30, 2019, and do not include the period of COVID-19 pandemic. Therefore, we extend the sample period up to March 30, 2020, and re-estimate the degree of market efficiency in the cryptocurrency markets.¹ Then we investigate the impact of the incident for cryptocurrency markets.

Figure A.1 shows the time-varying degree of market efficiency with 99% confidence intervals.

(Figure A.1 around here)

From the above figure, we find that the COVID-19 pandemic hardly affects the market efficiency for either Bitcoin or Ethereum. Moreover, we compare the impacts between the incident of “Mt.Gox” and the COVID-19 pandemic on the Bitcoin market. Figure A.1 also shows that the impact of the latter is much lower than the former. Thus, we conclude that the cryptocurrency markets have remained efficient although we take account of the rapid price decrease owing to the COVID-19 pandemic.

References

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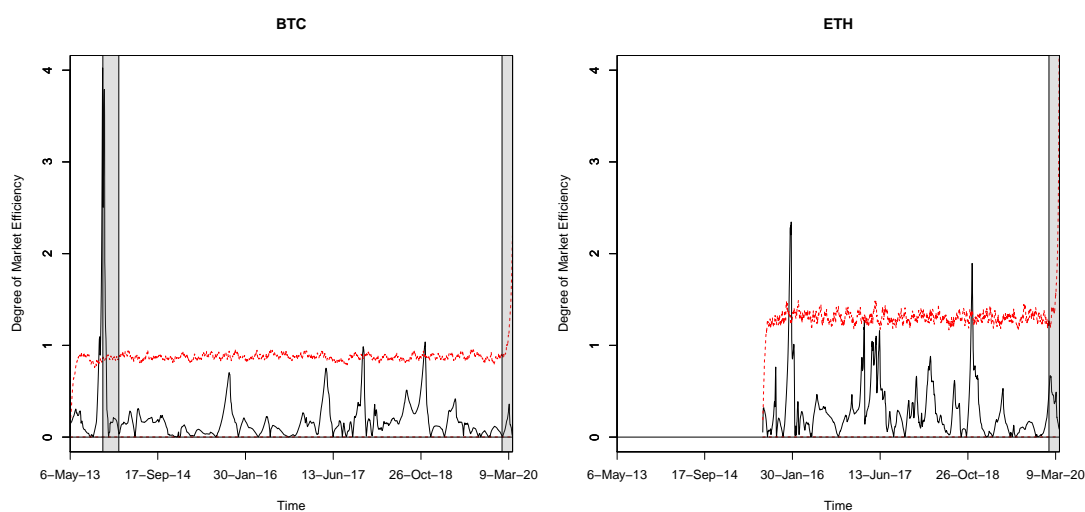
¹We utilize the daily prices of Bitcoin and Ethereum obtained from the CoinMarketCap website (<https://coinmarketcap.com>).

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Figure A.1: Time-Varying Degree of Market Efficiency



Notes:

- (1) The figure shows the time-varying degree of market efficiency for BTC (left panel) and ETH (right panel).
- (2) The shaded areas are consistent with the periods of the external shocks such as the “Mt.Gox” incident and the “COVID-19 pandemic.”
- (3) The dashed red lines represent the 99% confidence intervals of the efficient market degrees.
- (4) We run bootstrap sampling 10,000 times to calculate the confidence intervals.
- (5) R version 3.6.3 was used to compute the estimates.