

Subject

Pricing financial derivatives on the Bitcoin market

Supervisors, contact, place of research

dr hab. Piotr Nowak, prof. IBS PAN (pnowak@ibspan.waw.pl, tel. 223810393), IBS PAN, Newelska 6

Scientific discipline

Technical Computer Science and Telecommunications

Recruitment form

interview

Number of candidates

1

Project Description

Bitcoin (BTC), created by a person or group of persons known under the pseudonym Satoshi Nakamoto in 2009, still remains a most popular cryptocurrency. The system of BTC transactions, which does not require a financial intermediary, is based on a peer-to-peer network, fixed rules and cryptography (see [1]). As it was mentioned in [1] and references therein, BTC behaves as a high volatility stock and the high volatility of its price may depend on sentiment about the BTC market.

Financial derivatives on BTC, including European options, have been recently traded on appropriate websites. In [1], the BTC price and dynamics of the BTC sentiment indicator are modelled by continuous stochastic processes, described by a system of stochastic differential equations. Moreover, the BTC sentiment indicator affects the BTC price at time t up to a certain time preceding t . The authors proved that, under appropriate assumptions, the model is arbitrage-free, derived a pricing formula for European style derivatives on BTC, and proposed an estimation method for the considered model. They also fitted the model to market data, assuming that the volume and the number of Google searches are proxies for the sentiment factor.

In traditional Black–Scholes (BS) model, the underlying asset price was described by a geometric Brownian motion. However, besides advantages of the BS approach, which are an analytical option pricing expression and the completeness of the BS financial market model, it has drawbacks (see [2]). Therefore, some alternatives for BS model have been proposed, including approaches using Levy processes with jumps to model underlying assets (see, e.g. [3–6]).

The proposed research work, using advanced mathematical and computer science methods, concerns introducing jump parts to the model considered in [1], derivation of the valuation expressions for financial derivatives on BTC as well as proposition of an estimation method for the generalized model. The process of fitting this model to market data will require application of various computational techniques. Additionally, it would be interesting to take into consideration features associated with the BTC technology, other than sentiment about the BTC market.

Bibliography

1. A. Cretarola, G. Figà-Talamanca, and M. Patacca. A Sentiment-Based Model for the BitCoin: Theory, Estimation and Option Pricing. Preprint arXiv:1709.08621, 2017.
2. M. Davis. Mathematics of Financial Markets, in: Mathematics Unlimited, Springer, 2001.
3. R. Merton. Option pricing when underlying stock returns are discontinuous. J. Financ. Econ. 3, 125–144, 1976.
4. S. G. Kou. A jump-diffusion model for option pricing. Manag. Sci. 48(8), 1086–1101, 2002.
5. D. B. Madan and E. Seneta. The variance Gamma (V.G.) model for share market returns. J. Bus. 63(4), 511–524, 1990.
6. P. Nowak and M. Pawłowski. Pricing European options under uncertainty with application of Levy processes and the minimal L^q equivalent martingale measure. J. Comput. Appl. Math. 345, 416–433, 2019.

Date: April 30, 2020