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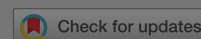
Weak efficiency of the cryptocurrency market: a market portfolio approach

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Pages 1627-1633 | Published online: 25 Mar 2019

Cite this article

<https://doi.org/10.1080/13504851.2019.1591583>



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ABSTRACT

Cryptocurrencies have been given the status of a market portfolio in the literature. In 2016–2017, three major cryptocurrencies (Bitcoin, Ethereum and Litecoin) showed a behavior similar to the market portfolio. This paper creates a market portfolio for the cryptocurrency market.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

¹ From 1 January 2014 to 31 December 2017 there are only 13 cryptocurrencies that have been trading the entire sample period. This period has not been analysed due to the scant number of digital currencies in comparison with the rest of the market portfolios.:

² We have only analysed those cryptocurrencies that have been trading for at least one year (2017) in order to obtain robust results. The list of the different cryptocurrencies is provided as supplementary material.

³ Considering our data, during 2015–2017 there are 59 cryptocurrencies in 2016 (sample 2015–2017), 50 in 2015 (sample 2014–2016), and 40 in 2014 (sample 2013–2015), compared to 2016.

⁴ Given the sample period (2015–2017), 2015 is the first year of the sample, 2016 is the last year of the sample, and 2017 is the year of the sample. The efficiency of the market portfolio is measured using the Jensen's alpha, which is included in the regression model. The results are presented separately for each year since the results are not significantly different. The result will be related to the sample period.

⁵ We use the market portfolio as a benchmark. Properly the market portfolio is defined as the sum of all the market returns. For robustness purposes, having calculated the returns of the market portfolio,



we transform the simple market returns into logarithm market returns, $\ln(1+r_{m,t})=r_{m,t}$, obtaining similar results (see [Table A1](#) in the Appendix).

⁶ This definition of random walk is the most restrictive one, which is denoted as random walk 1 by Campbell, Lo, and MacKinlay et al. ([1997](#)). We obtain the random walk 2 and 3 by relaxing the main assumptions. The random walk 2 includes processes characterized by independent but not identically distributed increments. On the other hand, for the random walk 3, we only hold the uncorrelated increments assumption, i.e. processes with dependent but uncorrelated increments (Campbell, Lo, and MacKinlay et al. [1997](#); Escanciano and Lobato [2009b](#)).

⁷ Despite the fact that there is not a strict connection between random walks and the Efficient Market Hypothesis (e.g. LeRoy ([1973](#)) and Lucas Jr ([1978](#)) show that the Efficient Market Hypothesis holds at the same time that prices do not follow random walks), in the empirical finance literature, authors are focused on the weak-form efficiency to examine whether future price changes are purely unpredictable based on the asset's price history (LeRoy [1973](#); Escanciano and Lobato [2009b](#)).

⁸ We test the joint hypothesis that all the autocorrelation coefficients (up to 3 lags) are simultaneously zero.

⁹ Given that in the case of the BDS test it is necessary to choose the embedding dimension and p-value, we report the statistics

¹⁰ The o period 2015-2017 for the Appendix



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