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Another Look at Cryptocurrency Bubbles

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Another Look at Cryptocurrency Bubbles

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Abstract

This paper deals with cryptocurrency bubbles. First, it points out that a number of recent papers on cryptocurrency bubbles are flawed due to an insufficient consideration of the fundamental value of cryptocurrencies. As even fiat money is said to exhibit features of bubbles, the same applies to cryptocurrencies. Thus, any empirical investigation into either the presence of cryptocurrency bubbles or the fundamental value of cryptocurrencies is needless. Second, the paper conducts a short empirical analysis into the relationship of the prices of Ethereum and Bitcoin. Evidence of explosive periods is found in the price of Ethereum even if this price is expressed in terms of Bitcoin rather than US Dollars. These periods, however, are found to be in the first half of 2016 and 2017, respectively, but not during the price peak period of Bitcoin witnessed end of 2017 and beginning of 2018.

Keywords: Cryptocurrencies, Bubbles, Bitcoin, Ethereum, fundamental value, intrinsic value, fiat money

JEL-Classification: C12, C22, E42, E52, G12

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1 INTRODUCTION

Motivated by the frequent enormous price increases cryptocurrencies such as Bitcoin exhibit, a lively debate emerged whether or not there are cryptocurrency bubbles. As a bubble is conventionally defined as an asset price that diverges from its fundamental value (Diba and Grossman, 1988), the essential question in this context is the following: what is the fundamental value of a cryptocurrency? This paper contributes to the literature on cryptocurrency bubbles in two distinct ways. First, it argues that the existing literature is lacking economic substance. Second, this paper proposes to study the relationship between different cryptocurrency prices rather than price behavior of individual ones.

While it is widely acknowledged that the intrinsic value of cryptocurrencies is zero, nevertheless attempts are undertaken to investigate both the existence of cryptocurrency bubbles and the fundamental value of cryptocurrencies. This paper argues that the distinction in intrinsic value and fundamental value is not useful in this context. Drawing a parallel to the discussion on bubbles in fiat money (Tirole, 1985; Dow and Gorton, 1993) it can be argued that, if fiat money's intrinsic value is zero and, hence, money exhibits features of a bubble, the same applies to cryptocurrencies - by definition. Thus, any empirical investigation into cryptocurrency bubbles is needless. The moment the value of a cryptocurrency becomes different from zero - usually shortly after the creation of the currency - the bubble starts and, unless the value of the cryptocurrency drops to zero, the bubble persists.

The analysis of the relationship between different cryptocurrencies tests the assumption that all cryptocurrencies are driven by the same speculative pattern and, thus, the price relationship should be stable. Expressing the value of Ethereum not in US Dollar but in Bitcoin and using a conventional test for explosiveness shows that this Ethereum-Bitcoin exchange rate is explosive in certain periods. In other words, Ethereum prices changes are disproportionately larger than Bitcoin prices in these periods; interestingly, however, mainly during earlier cryptocurrency episodes in the first half of 2016 and 2017, respectively, but not during the price peak period of Bitcoin witnessed end of 2017/beginning of 2018.

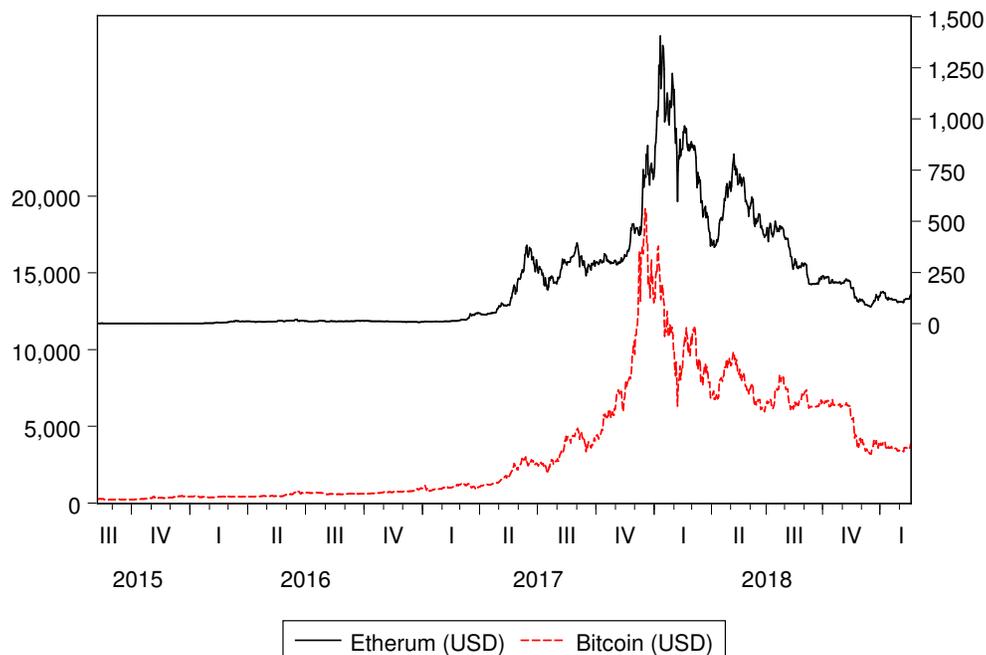
2 BUBBLES IN CRYPTOCURRENCIES

Subsequent to the creation of Bitcoin, various other cryptocurrencies emerged. This paper deals with Ethereum and Bitcoin. Figure 1 vividly illustrates why the question of cryptocurrency bubbles arose.¹ Drastic increases in the value of these currencies occur frequently and, what is more, roughly simultaneously. Various studies analysed if bubbles exist in the price of individual cryptocurrencies expressed in US Dollars.² The early contribution by Cheung et al. (2015) applies Phillips et al.'s (2011) popular procedure and finds evidence of a bubble. The essential question of the fundamental value is addressed in this paper but circumvented by referring to the com-

¹Period of observation: 09/08/2015-18/02/2019; all data from www.coinmarketcap.com.

²An enormous empirical literature on Bitcoin and other cryptocurrencies emerged recently. See Gronwald (2019) for one of the most recent contributions. That paper also provided a comprehensive overview of the literature.

Figure 1: Bitcoin and Ethereum prices - expressed in US Dollars



mon assumption that explosiveness is a key feature of price bubbles.³ This procedure ignores the possibility that also the fundamental value of an asset can change drastically.⁴ Cheah and Fry (2015) also deal with this issue and come to a similar finding. In addition, they employ an empirical procedure to estimate the fundamental value and find that this value is equal to zero. This is problematic insofar as this fundamental value is derived from observed prices rather than thorough economic reasoning as in the analysis of

³This issue is discussed in more detail below.

⁴This is the conclusion of Gronwald's (2016) analysis of the crude oil market. Phillips et al. (2011) also highlight that explosive price behavior can be caused by "rational responses to economic fundamentals".

stock markets where the fundamental value of stock prices is assumed to be the discounted stream of expected future dividends; see Diba and Grossman (1988). Corbet et al. (2018) undertake the attempt to explicitly take the fundamental value into account; their approach is based on blockchain position, hashrate, and liquidity. They construct three measures that are supposed to capture "key theoretical components of cryptocurrency pricing structures". Bouri et al. (2018), in contrast, are more careful; they emphasize that due to the lack of clarity in this issue, an analysis if a cryptocurrency is not possible; they focus only on explosiveness. The innovative aspect of that paper is that they analyse so-called co-explosivity between Ethereum and Bitcoin prices. It is important to note that Diba and Grossman (1988) discuss two empirical procedures to identify (rational) bubbles: one is based on the order of integration and, thus, statistical properties of observed prices; the other on testing for cointegration between observed price and fundamental value. However, also the former is based on the fundamental equation that observed prices consists of a fundamental component as well as a bubble component.

Most of the studies discussed above, in one way or the other, acknowledge that cryptocurrencies do not have any intrinsic value; however their observed value is different from zero. This essentially reflects Ali et al.'s (2014) assertion that "digital currencies have meaning only to the extent that participants agree that they have meaning". These studies, nevertheless, undertake attempts to investigate both the existence of cryptocurrency bubbles and their fundamental value. From a monetary theory perspective, these efforts are needless. Cryptocurrencies share with fiat money the fea-

ture of not having an intrinsic value, but still having a value different from zero. In the context of fiat money, the notion exists that fiat money exhibits features of a bubble; see in particular Tirole (1985) as well as Dow and Gorton (1993).⁵. The following two quotes epitomise this notion:

“Since Samuelson (1958) developed his consumption loan model it has been well known that there exist economies in which money has a positive value in spite of the fact that it is intrinsically useless (i.e., its market fundamental is zero). In other words there can exist a bubble on money where a bubble is defined as the difference between the market price and the market fundamental.”
(Tirole, 1985, p1499)

“The standard model has the property that money is valuable in equilibrium, even though it has no intrinsic value. It is often viewed as a bubble for this reason.” (Dow and Gorton, 1993, p23)

If fiat money exhibits features of a bubble, the same must apply to cryptocurrencies. In other words, their fundamental value is equally zero, but by definition; an empirical analysis into this value is not necessary and the distinction in intrinsic value and fundamental value misleading. Thus, there are cryptocurrency bubbles, but they started with the creation of the currency and, unless their value drops to zero, they will persist. The price behavior of the currency is not relevant in this context.

⁵Other studies often cited in this context are Samuelson (1958), Wallace (1980), Kiyotaki and Wright (1989), and Starr (2003)

3 THE ETHERUM-BITCOIN EXCHANGE RATE

The existence of multiple cryptocurrencies allows one to analyse the relationship among those - issues such as volatility spillovers and volatility connectedness have already been addressed; see e.g. Yi et al. (2018). Based on the finding of the empirical literature that cryptocurrencies are mainly a speculative asset, it is not implausible to assume that all cryptocurrencies follow the same overall speculative pattern and, thus, there should be a more or less stable relationship between these price series. Figure 2 presents the price of Ethereum expressed in terms of Bitcoin.⁶ It is evident that this series is far from stable. There are certainly rather horizontal movements in some periods such as 2016 and the second half of 2018, but also drastic changes in this series, essentially resembling those explosive periods exhibited by cryptocurrencies expressed in US Dollar. This series is now analysed using Phillips et al.'s (2011) well-established SADF test.

This standard procedure consists of a forward recursive application of an augmented Dickey-Fuller unit root test. The null of a unit root is tested against the alternative of an explosive root. Thus, the following equation is estimated:

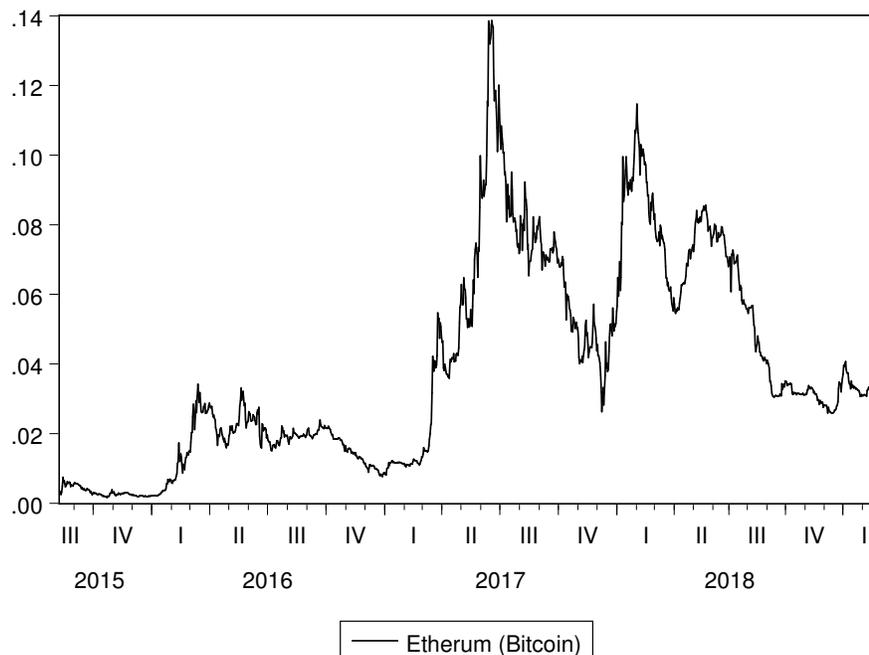
$$x_t = \mu_x + \delta x_{t-1} + \sum_{j=1}^J \phi_j \Delta x_{t-j} + \epsilon_{x,t}, \quad \epsilon_{x,t} \sim \text{NID}(0, \sigma_x^2). \quad (1)$$

The hypothesis $H_0: \delta = 1$ is tested against the alternative $H_1: \delta > 1$.⁷

⁶By expressing Ethereum in terms of Bitcoin, it is assumed that the most popular and oldest cryptocurrencies, Bitcoin, is the leading cryptocurrency.

⁷Note that this is a standard unit root test except for the formulation of the alternative hypothesis. Rather than testing the null of a unit root against a stationary alternative, the alternative in this case is explosive.

Figure 2: Ethereum prices - expressed in Bitcoin



Initially, a subset of the sample with $\tau_0 = nr_0$ observations is used. In each subsequent regression, this subset is supplemented by successive observations, giving a sample of size $\tau = nr$ for $r_0 \leq r \leq 1$. This procedure yields a sequence of t -statistics with corresponding p-values. These sequences are used to identify origination \hat{r}_e and collapse dates \hat{r}_f of explosive behavior in the data:

$$\hat{r}_e = \inf_{s \geq r_0} \{s : \text{ADF}_s > \text{cv}_{\beta_n}^{\text{adf}}(s)\}$$

$$\hat{r}_f = \inf_{s \geq \hat{r}_e} \{s : \text{ADF}_s < \text{cv}_{\beta_n}^{\text{adf}}(s)\}$$

where $\text{cv}_{\beta_n}^{\text{adf}}(s)$ stands for the critical value.⁸

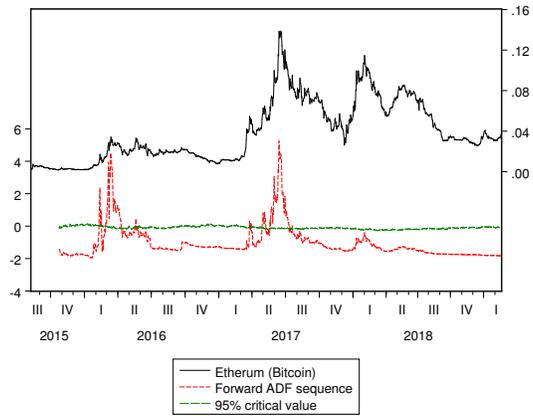
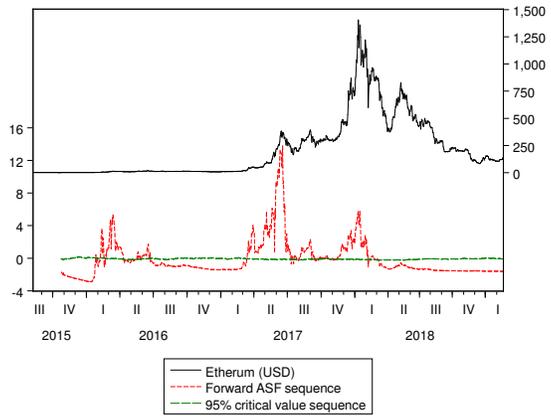
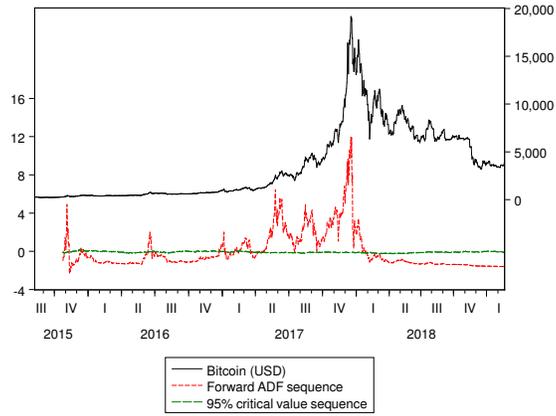
Figure 3 displays the results. The upper and middle panel shows the ADF sequence as well as the critical values for the cryptocurrencies quoted in US Dollars, the lower panel for Ethereum quoted in Bitcoin. Whereas the two former exhibit explosive behavior throughout the sample period, evidence of explosiveness of the latter is found only in the first half of 2016 and 2017, respectively, but not during the price peak period of Bitcoin at the turn of the year 2017/2018. The interpretation is the following: Ethereum and Bitcoin are generally driven by the same speculative pattern; however in certain periods the value of Ethereum is explosive even if expressed in terms of Bitcoin. This reflects that in these periods the change in Ethereum prices is disproportionately larger than change in Bitcoin prices.

4 CONCLUSIONS

There is no question that cryptocurrency bubbles are present. The existing literature on this issue, however, lacks economic substance: as fiat money does not have an intrinsic value, the same applies to cryptocurrencies. In other words, both are, by definition, characterised by bubbles as soon as their observed value is different from zero. An empirical analysis into either

⁸In the empirical application, the critical values are simulated using the Monte Carlo technique; see Phillips et al. (2011).

Figure 3: Tests for explosiveness.



the existence of cryptocurrency bubbles or their fundamental value is not required. The existence of multiple cryptocurrencies, however, allows one to analyse the relationship between the values of cryptocurrencies. A simple empirical analysis shows that Ethereum prices show explosive behavior even if expressed in terms of Bitcoin; however mainly in earlier periods and not during the Bitcoin record period. This certainly does not mean that the bubble disappeared; it just means that extreme overreactions are less common in more recent periods.

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