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Was there a bubble in the ICO market?

Mikhail Stolbov
Moscow State Institute of International Relations (MGIMO-University)

Abstract

The paper aims to detect and date-stamp explosive behavior in the initial coin offering (ICO) market since its inception until February 2019. To this end, I conduct a 2x2 empirical exercise by applying two well-established statistical tests for speculative bubbles, the generalized supremum ADF test (Phillips et al., 2015) and the technique proposed by Franses (2016), to two authoritative datasets on monthly ICO dynamics. Bubble patterns are found for this market during May-June 2017 and December 2017-January 2018.

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Contact: Mikhail Stolbov - stolbov_mi@mail.ru.
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1 Introduction

Price bubbles often occur in immature, but rapidly growing markets. One of the recent examples is the cryptocurrency market. Explosive price patterns have been extensively investigated with respect to Bitcoin and other important cryptocurrencies. The extant literature supports the view that there was a full-fledged bubble in this market in 2017-early 2018, e.g. Bouri et al. (2018), Cagli (2018), Corbet et al. (2018), Fry (2018), Geuder et al. (2018).

Against this backdrop, it is natural to examine if similar explosivity is present in the market for initial coin offerings (ICO), which feeds the cryptocurrency market with new coins and tokens. To the best of my knowledge, this paper is the first to raise such a research question. While public concerns about a potential ICO market bubble were first expressed in April 2017[1], previous academic literature focused on the determinants of successful ICOs (Adhami et al., 2018; Blaseg, 2018; Howell et al., 2018) and their regulatory challenges (Hacker and Thomale, 2018), leaving out the issue of potential bubble formation.

In this study, using the data on monthly ICO dynamics for January 2014-February 2019 from an authoritative source, https://www.icodata.io, I test for speculative bubbles in the ICO market by applying the generalized supremum ADF test (GSADF) (Phillips et al., 2015) and the technique proposed by Franses (2016). Albeit different in the methodology, both procedures not only enable to detect bubbles in the series, but also date-stamp them. To examine the robustness of the baseline results, I adopt the same tests to another publicly available dataset on monthly ICO volumes, https://www.tokendata.io/.

Based on the concurring results of such 2x2 exercise (i.e. two tests for speculative bubbles applied to the two datasets), I dissect two periods with the explosive dynamics of ICO volume, namely, during May-June 2017 and December 2017-January 2018.

The remainder of the paper is as follows. Section 2 describes the data and introduces the methodology. The baseline results are represented in Section 3. Section 4 reports the results of the robustness check, while Section 5 concludes.

2 Data and methodology

2.1 Baseline ICO data

An ICO is a fundraising mechanism for new cryptocurrency ventures. It is loosely regulated in most jurisdictions and implies that investors allocate funds (usually in the form of a cryptocurrency, e.g. bitcoin or ether) to a smart contract which stores the funds and subsequently distributes an equivalent value in the new token.

Since this fundraising mechanism is a new phenomenon, there is no benchmark database on ICO. In this study, I use the data on monthly ICO volumes borrowed from https://www.icodata.io, which provides ICO cumulative funding statistics from 2014 onwards. I opt for this dataset as a baseline source as it is arguably the most comprehensive among very few publicly available ones. Besides, it has been featured in a number of influential publications, e.g. *New York Times*, *Forbes*, *Huffington Post*. The sample period in the paper covers January 2014-February 2019.

As shown in Fig. 1, the first ICOs were launched in 2014. After two years of anemic growth, the market began to expand rapidly in the early 2017. The expansion reached its peak in December 2017, with the monthly ICO volume equal to almost 1.7 bln dollars. In the

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[1] For example, see the article entitled "The market in initial coin offerings risks becoming a bubble" from *The Economist* dated April 27th, 2017 (https://www.economist.com/finance-and-economics/2017/04/27/the-market-in-initial-coin-offerings-risks-becoming-a-bubble).

subsequent months, the indicator started to decline at a high pace. Eventually, by the early 2019, monthly ICO volumes shrank to the pre-2017 level. This incredibly volatile dynamics points to a potential bubble occurrence.

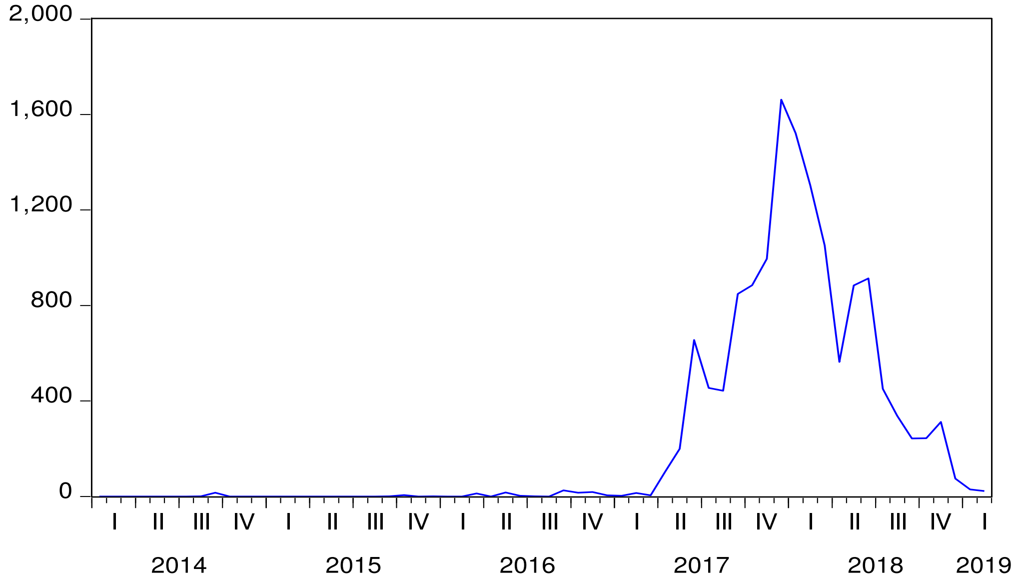

Figure 1. Dynamics of monthly ICO volume, January 2014-February 2019.

Source: https://www.icodata.io

Non-stationarity of the raw data is a prerequisite to test for a speculative bubble. Thus, I first run the ADF unit root test for the whole sample. The test indicates that the order of integration of the series is I(1). Since results of the conventional unit root tests may be biased due to the presence of structural breaks, I also adopt the breakpoint ADF test, which corroborates the non-stationarity of ICO dynamics[2].

2.2 Tests for speculative bubbles

The GSADF test is the most flexible technique in the family of right-tailed ADF tests developed by Phillips et al. (2011, 2015). The test applies to dissect bubbles in various asset markets, including the cryptocurrency market[3]. Besides, it can be used to detect the bubbly dynamics of economic variables which are not asset prices, but rather aggregate indicators exhibiting long-term equilibrium levels. Such levels are akin to the intrinsic values of assets. Substantial upward deviations from them are not favorable for a particular sector or the whole economy and are associated with subsequent manifestations of instability. For example, by applying the GSADF test to credit-to-GDP ratio, house price-to-income ratio and debt service costs, Virtanen et al. (2018) argue that this test can be adopted to foresee financial crises in a way similar to early warning models. Liu et al. (2015) apply the GSADF test to investigate if there was excess liquidity in the Chinese monetary system during 1992-2013. In a recent paper, Chen and Wu (2018) use a battery of tests for speculative bubbles, including the GSADF test, to study the sustainability of an aggregate measure of government debt in nine advanced economies. Against this backdrop, I conjecture that ICO volumes should also have a long-term equilibrium. Large upward deviations from it are likely to be speculative and can be captured by the tests for bubbles.

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[2] The detailed output for the two tests is available from the author upon request.

[3] Its popularity is confirmed by *Google Scholar* counts for the papers by Phillips et al. (2011, 2015) which total 679 and 459 citations, respectively, as of October 2019.

The GSADF is a recursive and rolling test wherein the null is of a unit root and the alternative is of a mildly explosive process. It allows to detect and date-stamp multiple periodically collapsing bubbles, whereas its earlier versions (right-tailed ADF and supremum ADF tests) enable to underscore single bubble episodes.

Formally, the test strategy involves estimating the following reduced form equation:

$$y_t = \mu + \delta y_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta y_{t-i} + \varepsilon_t \,, \qquad (1)$$

where y_t is monthly ICO volume, μ is an intercept, p is the maximum number of lags, φ_i are the differenced lags coefficients and ε_t is an error term. The null hypothesis of the GSADF test implies that $\delta = 1$, while the alternative suggests that $\delta > 1$. To implement the test, rolling regressions based on eq. (1) are estimated on a backward expanding sample sequence. The test statistic is obtained as the sup value of the corresponding ADF statistics (t-statistics) in the subsample sequence. To date-stamp the origination of a bubble, this statistic should cross the critical value from below. Conversely, the chronological point in which the statistic crosses the critical value from above signifies the bubble collapse[4].

The second test proposed by Franses (2016) builds on the idea that there is an unbalance between growth and acceleration for the time-series, exhibiting explosive patterns. Growth is defined as a first difference of the data, or $(1-L)y_t$, to use time-series notation, where L denotes a lag operator. Acceleration is understood as $(1-L)^2 y_t$. Therefore, the unbalance between growth and acceleration implies that for some time points they are both positive and mutually reinforcing. Such a feedback drives the data to ever higher levels, mimicking a bubble formation.

This test is easy to implement, as it is not computationally intensive. It can be shown formally that under no-bubble condition the following series:

$$(1-L)y_t - 0.5(1-L)^2 y_t = 0.5(1-L^2)y_t \qquad (2)$$

has a stable mean and does not exhibit explosive behavior. Once the balance between growth and acceleration is violated, the presence of explosive behavior can be detected by means of the regression of the variable $(1-L^2)y_t$ on an intercept and the inspection of the associated one-step-ahead forecast errors based on the recursive residuals. These residuals are used in time series analysis to capture structural shifts and changes in variance. To control for residual autocorrelation, these lags can be included. Thus, the Franses technique for bubble detection boils down to a test for a non-explosive vs. explosive ARMA series.

3 Baseline results

The GSADF test rejects the null of a unit root in favor of a mildly explosive process at the 1% level, thereby confirming the occurrence of bubble episodes in the ICO market (Table 1).

Table 1. The GSADF test results for monthly ICO volumes.

Sample: January 2014-February 2019		
Included observations: 62		
Null hypothesis: ICO has a unit root		
Lag length: Automatic selection based on the AIC, lag=1		
Rolling window size: 15		
	t-statistic	p-value
GSADF	8.77	0.00

[4] The GSADF test is performed on the basis of the EViews routine by I. Caspi. See Caspi (2017) for technical details. Lag length is chosen based on the AIC, while the maximum number of lags in the equation (1) is set to 4. The rolling window size is a default parameter in the EViews routine and equal to 15 given the length of the ICO volume series, i.e. approximately 25% of the observations.

Test critical values*	99% 95% 90%	2.70 2.00 1.63	

Note: * - critical values based on Monte Carlo simulation.

Fig. 2 date-stamps the bubble episodes, which appear to occur in May-July and December 2016, May-June 2017, September 2017- February 2018 and May 2018.

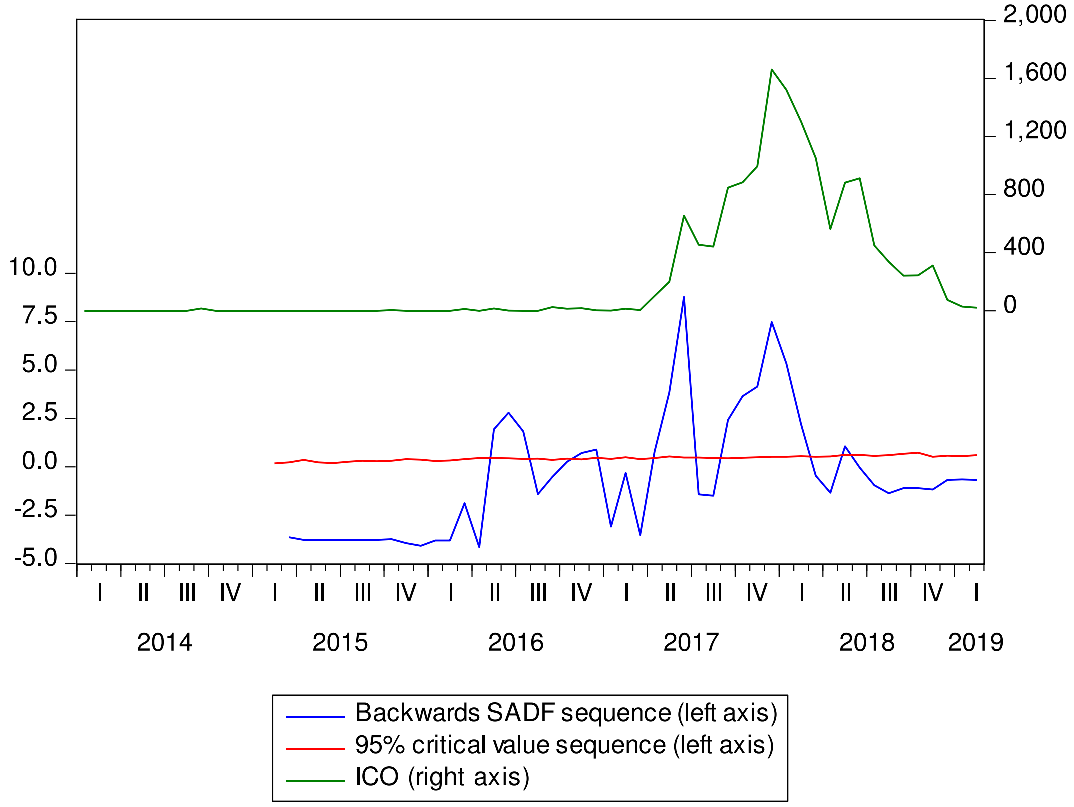

Figure 2. Date-stamping bubble episodes in the ICO market.

Then, I plot growth and acceleration, underlying the technique proposed by Franses (2016). The points lying in the upper right part of the scatterplot refer to the periods when these two parameters strongly reinforce each other, testifying to potential bubbles (Fig. 3).

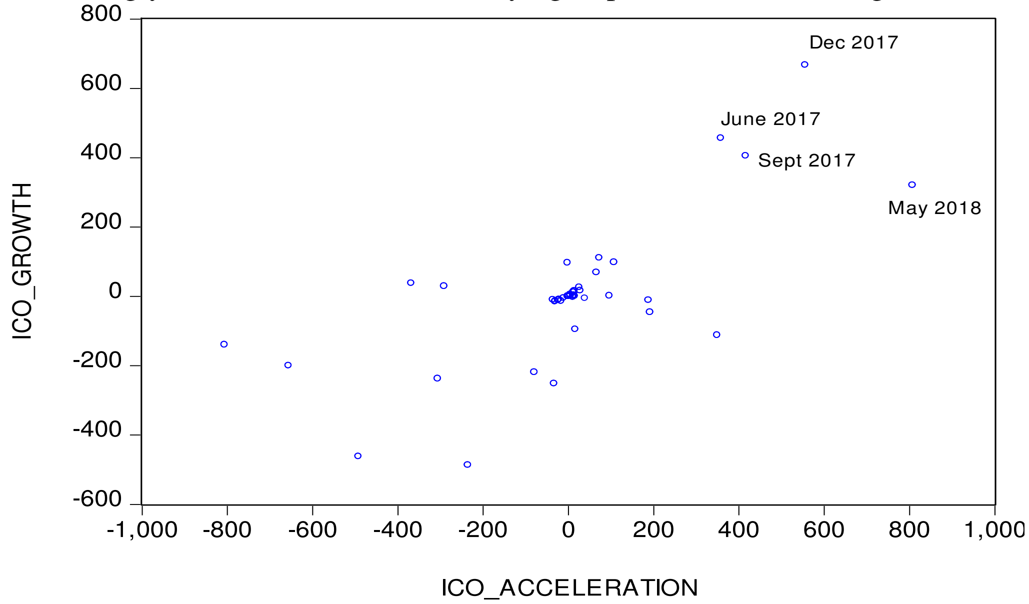

Figure 3. Monthly ICO dynamics, growth versus acceleration, full sample.

In line with the procedure described in Section 2.2, I estimate the regression of $(1 - L^2)ICO_t$ on an intercept and examine the associated one-step-ahead forecast errors based on the recursive residuals (Fig. 4).

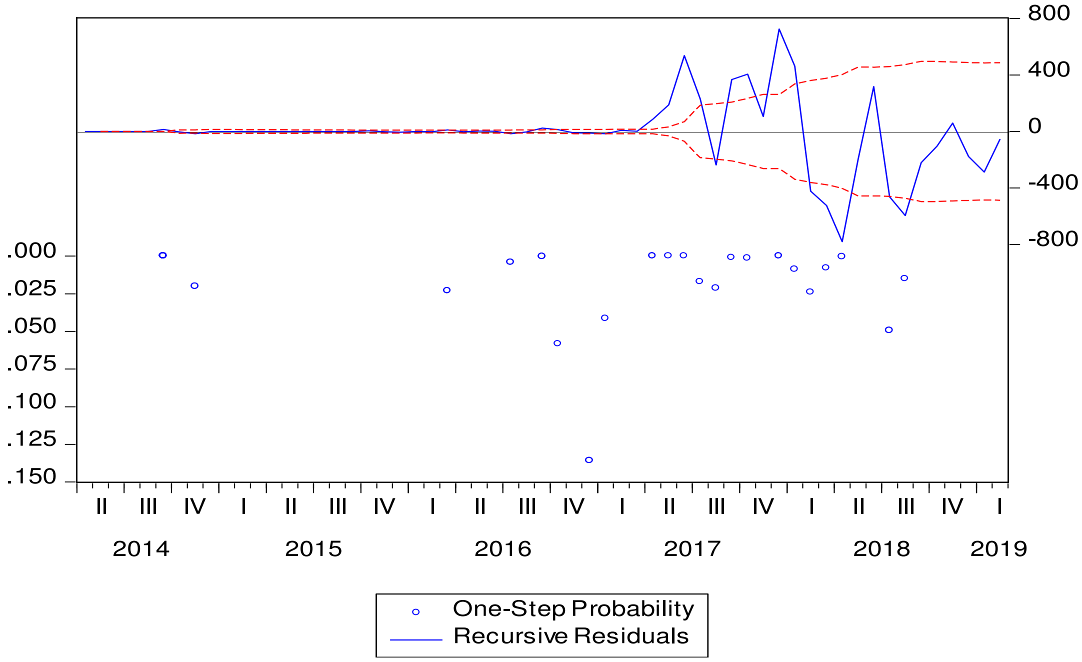

Figure 4. One-step-ahead forecast errors, recursive estimation of $(1 - L^2)ICO_t$ on a constant, full sample.

Explosive behavior is found for April-June 2017, September-October 2017 as well as for December 2017-January 2018. During these periods the one-step-ahead forecast errors based on recursive residuals exceed the upper confidence band, since the respective one-step p-values are clearly smaller than 0.05. These results partly overlap with the bubble date-stamping based on the GSADF test.

Overall, based on the baseline data from https://www.icodata.io, there is evidence of explosive dynamics in the ICO market during May-June 2017, September-October 2017 and December 2017-January 2018.

4 Robustness check

Boreiko and Vidusso (2019) show that the ICO aggregators and rating websites so far differ substantially in their data coverage. Thus, I exploit data on monthly ICO dynamics from another source, https://www.tokendata.io/ , to examine the robustness of the baseline findings. Like the baseline dataset, it contains statistics on ICO volumes since the inception of this market. The distinctive feature of https://www.tokendata.io is that the funds raised by means of an ICO are reported only when the offering is fully completed. In case of the ICOs, which involve a non-public pre-sale phase or which are organized in several rounds, such statistical methodology creates bias towards later reporting dates. For example, https://www.tokendata.io reports the proceeds from the ICO Telegram, totaling 1.7 bln US dollars, for April 2018, though the funds were actually split equally between two rounds. The first of them ended in February 2018, while the second one indeed finished in early April.

Nonetheless, the ICO dynamics based on https://www.tokendata.io has a statistically significant correlation ratio of 0.69 with the baseline data series. Due to the methodological nuance mentioned above, it exhibits pronounced peaks in April 2018 (ICO Telegram) and June 2018 (ICO EOS[5]) (Fig. 5).

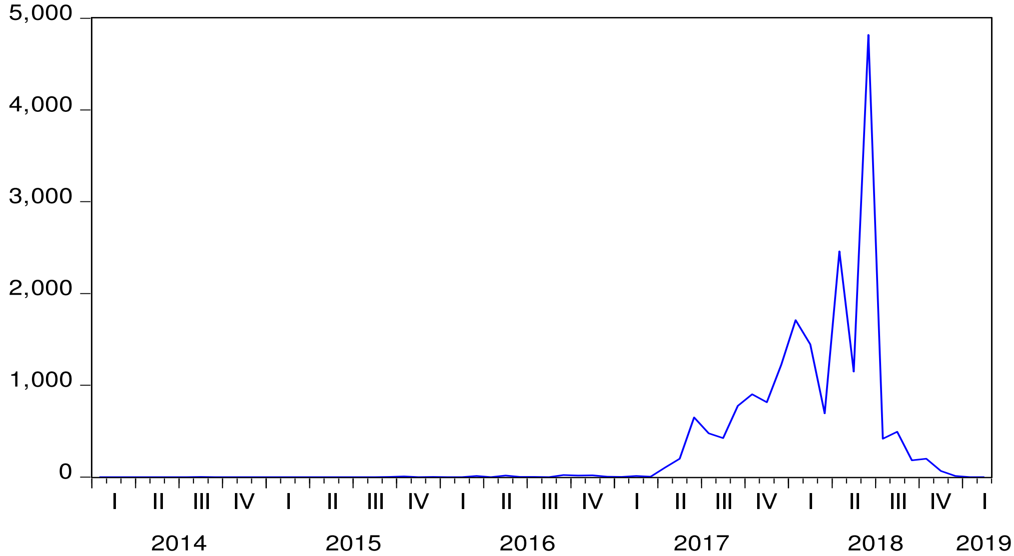

Figure 5. Dynamics of monthly ICO volume, January 2014-February 2019.
Source: https://www.tokendata.io

Like in the baseline case, both conventional and breakpoint ADF tests indicate the non-stationarity of the data, legitimizing the application of the GSADF and Franses tests for speculative bubbles.

The GSADF test unveils many more episodes of explosive behavior in the ICO market than in the baseline estimation: namely, for October 2015, March-July, November-December 2016, May-June 2017, September 2017-February 2018, April 2018 and June-October 2018 (Table 2, Fig.6).

Table 2. The GSADF test results for monthly ICO volumes.

Sample: January 2014-February 2019			
Included observations: 62			
Null hypothesis: ICO has a unit root			
Lag length: Automatic selection based on AIC, lag=1			
Rolling window size: 15			
GSADF		t-statistic	p-value
		7.94	0.00
Test critical values*	99%	2.70	
	95%	2.00	
	90%	1.63	

Note: * - critical values based on Monte Carlo simulation.

[5] The ICO EOS started in 2017 and consisted of 350 rounds.

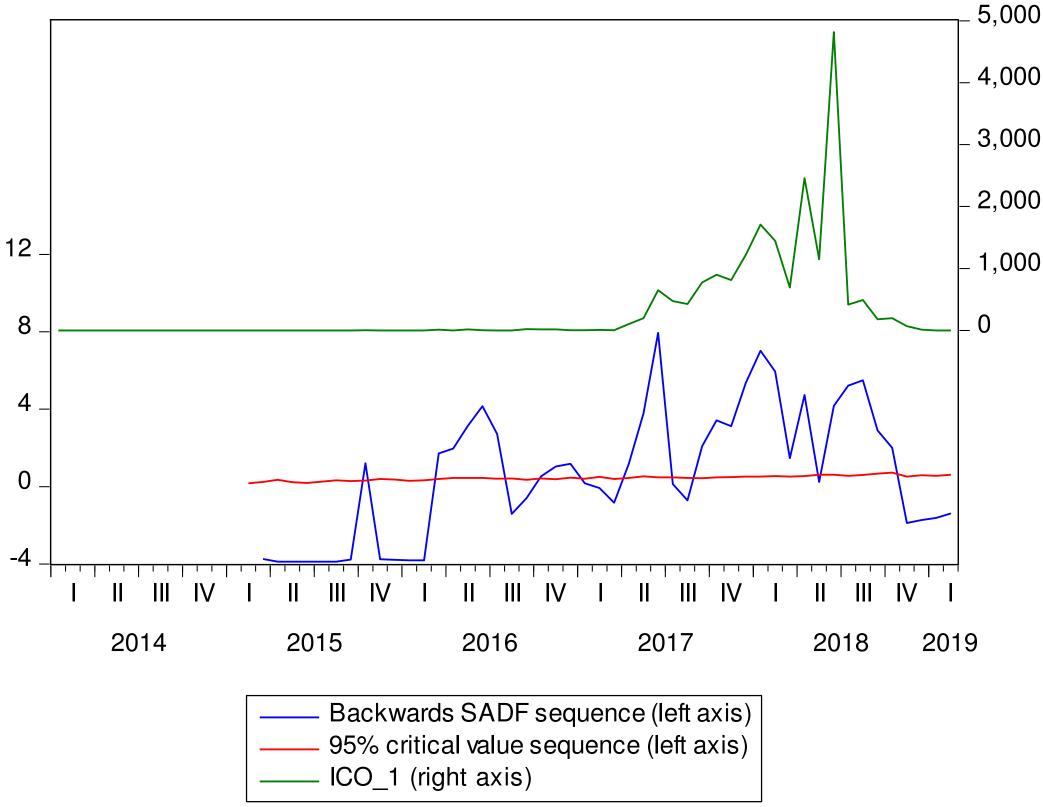

Figure 6. Date-stamping bubble episodes in the ICO market.

There are also signs of an unbalance between ICO volume growth and acceleration (Fig. 7), which underlies the Franses test. Its subsequent application points to the presence of bubbles during April-June 2017, September-October 2017, December 2017-January 2018, April 2018 and June 2018 (Fig. 8).

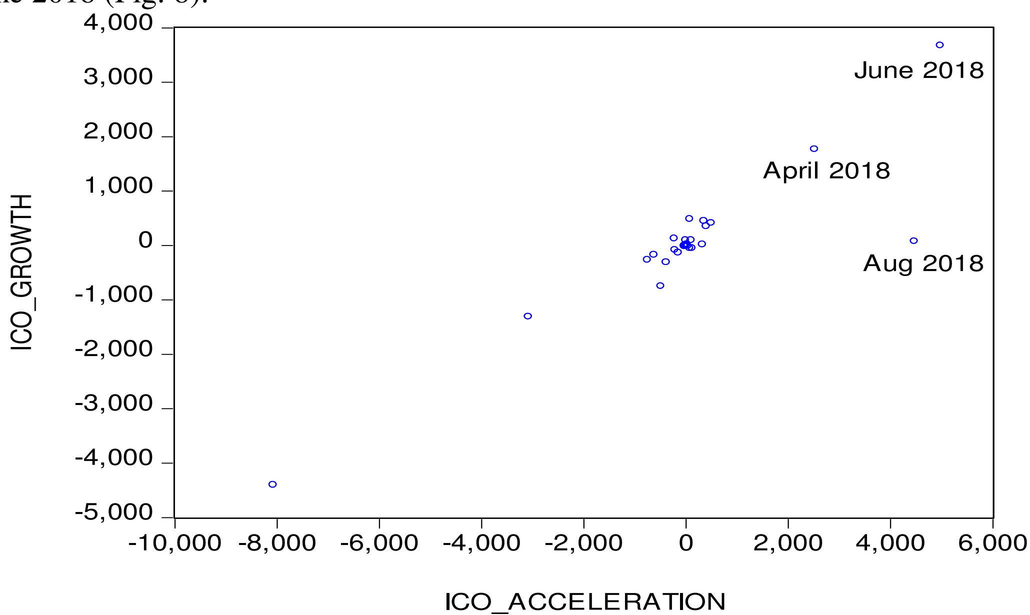

Figure 7. Monthly ICO dynamics, growth versus acceleration, full sample.

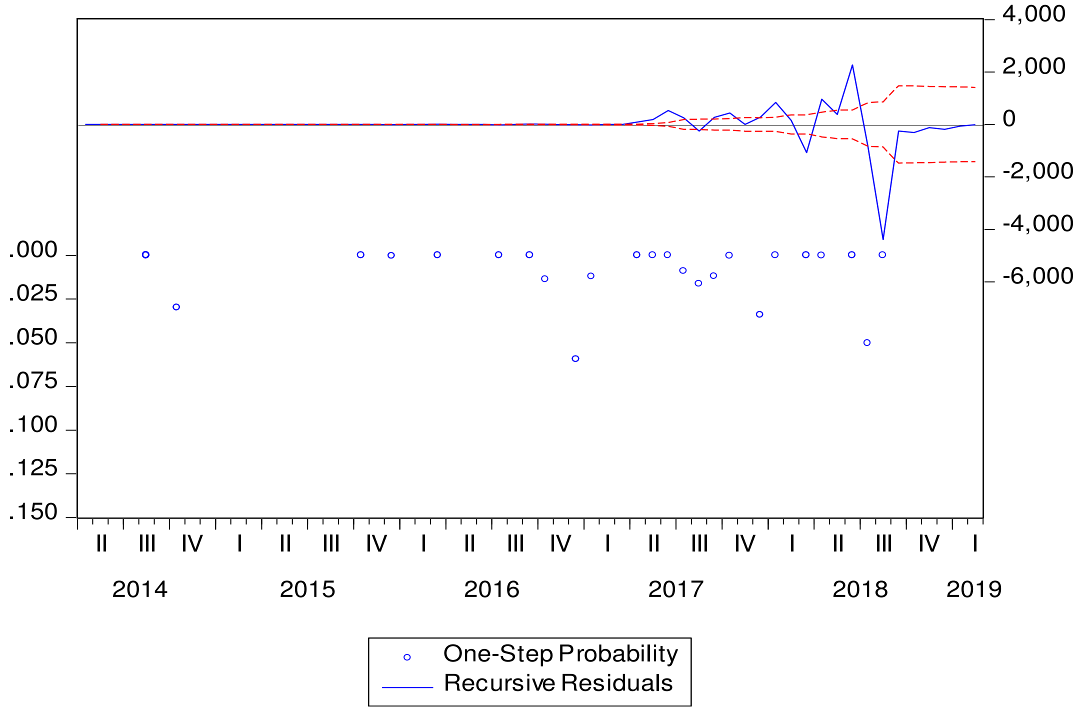

Figure 8. One-step-ahead forecast errors, recursive estimation of $(1 - L^2)ICO_t$ on a constant, full sample.

My empirical strategy to identify bubbles builds on strictly concurring results of the baseline estimation and the robustness check. Thus, I confirm that explosive behavior occurs during two periods: May-June 2017 and December 2017-January 2018. These time spans are consistent with the bubble dates for the Bitcoin and the cryptocurrency market as a whole, as revealed by Bouri et al. (2018) and Geuder et al. (2018). Yet, this short paper does not aim to explain such synchronization, leaving the investigation of ICO and cryptocurrency market spillovers and their determinants for future research[6].

5 Conclusions

Based on the results of the 2x2 empirical exercise, the study confirms the occurrence of explosive behavior in the ICO market during May-June 2017 and December 2017-January 2018. The bubble imploded in January 2018, and since then the market is unlikely to have been in a bubble state. An interesting follow-up to the paper would consist in examining dynamic linkages between the cryptocurrency and ICO market bubbles, thereby shedding light on a lead-lag relationship between these markets. In addition, the tests for bubbles implemented in the paper can be used to detect explosivity of standalone ICO price dynamics.

References

Adhami, S., G. Giudici, S. Martinazzi (2018) "Why Do Businesses Go Crypto? An Empirical Analysis of Initial Coin Offerings", *Journal of Economics and Business* 100(C), 64-75.

Blaseg, D. (2018) "Dynamics of Voluntary Disclosure in the Unregulated Market for Initial Coin Offerings", Mimeo. doi: http://dx.doi.org/10.2139/ssrn.3207641.

Boreiko, D., and G. Vidusso (2019) "New Blockchain Intermediaries: Do ICO Rating Websites Do Their Job Well?" *Journal of Alternative Investments* 21(4), 67-79.

[6] I am aware of a single paper by Masiak et al. (2018) that explicitly tackles this issue and finds bidirectional causal linkages between the two markets.

Bouri, E., S. Shahzad, D. Roubaud (2018) "Co-explosivity in the cryptocurrency market", *Finance Research Letters*, forthcoming, doi: 10.1016/j.frl.2018.07.005.
Cagli, E. (2018) "Explosive behavior in the prices of Bitcoin and altcoins", *Finance Research Letters*, forthcoming, doi: 10.1016/j.frl.2018.09.007.
Caspi, I. (2017) "Rtadf: Testing for Bubbles with EViews", *Journal of Statistical Software* 81, doi: 10.18637/jss.v081.c01.
Chen, S.-W., and A.-C. Wu (2018) "Is There a Bubble Component in Government Debt? New International Evidence", *International Review of Economics & Finance* 58, 467-486.
Corbet, S., B. Lucey, L. Yarovaya (2018) "Datestamping the Bitcoin and Ethereum bubbles", *Finance Research Letters* 26, 81-88.
Franses, P.H. (2016) "A Simple Test for a Bubble Based on Growth and Acceleration", *Computational Statistics and Data Analysis* 100(C), 160-169.
Fry, J. (2018) "Booms, Busts and Heavy-tails: The Story of Bitcoin and Cryptocurrency Markets?" *Economics Letters* 171(C), 225-229.
Geuder, J., H. Kinateder, N.F. Wagner (2018) "Cryptocurrencies as Financial Bubbles: The Case of Bitcoin", *Finance Research Letters*, forthcoming, doi: 10.1016/j.frl.2018.11.011.
Hacker, P., and C. Thomale (2018) "Crypto-securities Regulation: ICOs, Token Sales and Cryptocurrencies under EU Financial Law", *European Company and Financial Law Review* 15(4), 645-696.
Howell, S., M. Niessner, D. Yermack (2018) "Initial Coin Offerings: Financing Growth Cryptocurrency Token Sales", *NBER Working Paper* № 24774.
Liu, T.Y., C. Su, X. Jiang, T. Chang (2015) "Is There Excess Liquidity in China?" *China & World Economy* 23(3), 110-126.
Masiak, C, J. Block, T. Masiak, M. Neuenkirch, K. Pielen (2018) "The Market Cycles of ICOs, Bitcoin, and Ether", *Research Papers in Economics* 2018-04, University of Trier.
Phillips, P., Y. Wu, J. Yu (2011) "Explosive Behavior in the 1990s NASDAQ: When Did Exuberance Escalate Asset Values", *International Economic Review* 52(1), 201-226.
Phillips, P., S. Shi, J. Yu (2015) "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500", *International Economic Review* 56(4), 1043-1078.
Virtanen, T., E. Tölö, M. Viren, K. Taipalus (2018) "Can Bubble Theory Foresee Banking Crises?" *Journal of Financial Stability* 36, 66-81.