Bad News, Technical Development and Cryptocurrencies Stability

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Resumo

Cryptocurrencies are recent, yet they attract great interest and investments. The current level of market efficiency of these assets, nevertheless, is a subject that must be studied. If the asset is dependent on technology, critical failures of the technical structure must lead to negative returns. In such case, bad news about technology -- the so called Fear, Uncertainty and Doubt (FUD) periods -- are believed to play an important role in price fluctuations. In this paper, we argue FUDs indeed represent an important source of market uncertainty and affect negatively cryptocurrencies prices. Two negative technological reviews of alternative cryptocurrencies -- NEO and IOTA -- are the object of event studies. These cases reveal alternative cryptocurrencies possibly have semi-strong of Market Efficiency as prices quickly adjust to new public analyses of technology.

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ABSTRACT
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KEYWORDS
Cryptocurrencies; Asset Pricing; Market Efficiency

1. Introduction

Bitcoin, the first cryptocurrency, was created in 2009. It represented a disruptive advance as it allowed for digital scarcity, a problem not solved before. Since then, several modifications were devised with other objectives. For instance, the blockchain of Ethereum – another cryptocurrency – allows for smart contracts to be issued and enforced; Bitcoin Cash uses a larger block size in order to enable more transactions per second. Such alternative coins – so-called cryptocurrencies – compete over their technical possibilities, with different features over privacy, smart contracts and number of transactions.

This class of assets do not pay dividends, do not issue coupons or principals and no clear fundamental value is estimated. Prices are argued to relate to its usage as currency (Kristoufek 2015) or as a hedging tool (Bouri et al. 2017). Other approaches are related to finding a fundamental price: Metcalfe's Law is proposed as a tool for pricing cryptocurrencies (Alabi 2017); the marginal costs of miners (Hayes 2017) are also argued to cause prices. It is possible to argue that both factors are related to the usage of the underlying technological structure of cryptocurrencies.

The robustness of this structure is a necessary condition for cryptocurrencies to survive. A digital asset which decentralized computational structure is prone to attacks or failures may not be reliable for long-run investors. In traditional blockchains, imposing computational processing costs to actors that join the network guarantees the security of the public system. This scheme is called "Proof-of-Work" and demands electrical energy and specialized hardware to generate the hash rate. Hayes (2017) uses cross-sectional data to show hash rate is a determinant of cryptocurrencies prices.

Nonetheless, there is the possibility of reverse causality, as game theoretical models suggest the production of hash rate is dependent on prices (Chiu and Koeppl 2017; Civitarese 2018b). Core developers are developing alternative designs less dependent on electrical energy and more scalable in such cryptocurrencies, but they might be seen as experimental and possibly prone to unexpected failures due to its recency.

It is expected that any failures on the technology affects prices. Recently, Wang and Vergne (2017) had tested a technological development index on a panel of cryptocurrencies and found this factor is useful in pricing. This factor was related to GitHub and other observations, being an objective proxy for an cryptoasset technological development. Another factor frequently argued to influece prices is the attention devoted to the cryptocurrencies, with Online Searches (Dastgir et al. 2018), Online News (Polasik et al. 2015) and Wikipedia (Kristoufek 2013), among other sources, affecting cryptocurrency prices.

There is a problem about this: possibly there is an interaction between both factors. Only a few people indeed understand codes and technologies about cryptocurrencies: for instance, it is not expected that every investor understands what Delegated Byzantine Fault Tolerance – an important concept to comprehend NEO, a prominent cryptocurrency – is and how does it works. A way to know about the underlying technology is to follow experts and to way for their analyses; thus, technical issues are influenced by the information flow in market. The results by Wang and Vergne (2017) must be further refined in such case.

The role of the information flow in financial markets is predicted by the classical literature of market efficiency (Fama 1970). The weak form of market efficiency is related to the non-capacity of traders generating abnormal returns using past price data – a publicly available piece of data – and the semi-strong is related to the capacity of market to quickly adjust to any new publicly available information. If technical aspects really matter, then if a technical review about an digital asset is negative and the market is efficient, it is expected that this review influences negatively the returns.

The role of signaling highlights the importance of studies regarding the relationship between bad news spread and the stability of many cryptocurrencies. Some mechanisms connect informational threats to the resilience of blockchains. For Proof-of-Stake cryptocurrencies, Houy (2014) described a game-theoretical attack based on credible threats by large players; the impact of bad news might increase as well volatility and decrease price, leading to higher concentration according to Civitarese (2018b). The security of applications based on blockchain might be related to information and news; therefore, it is fundamental to investigate if this is a possible source of instability for new businesses based on decentralization and public blockchains.

Using the event study methodology (MacKinlay 1997), we provide evidence that this semi-strong form of market efficiency (Fama 1970) is present. Five Fear, Doubt and Fear (FUD) periods are analyzed. These periods are, according to pratictioneers, usually characterized by low returns and higher volatility due to uncertainty in a characteristic of the cryptoasset. After a brief literature review, section 2 focuses on explaining the theory behind case selection, and the currencies and their FUDS. Section 3 discusses the event study empirical design and section 4 presents the results. Section 5 concludes this paper.

2. Literature Review

2.1. *Technology and Fundamental Value in Bitcoin*

Crises and bubbles in cryptocurrencies are difficult to define as there is no clear source of fundamental value. In the early Bitcoin econometric literature, a very aggressive result was published by Cheah and Fry (2015); these authors have verified Bitcoin had no fundamental value at all. Since them, there were some attempts by both academics and practitioners about what might bring value to Bitcoin and other cryptocurrencies .

A source of fundamental value argued is the Metcalfe's Law: the value of a network is given by the square of its users. Alabi (2017) uses a curve-fitting approach to detect if there is a relationship between unique addresses and cryptoassets – Bitcoin, Ethereum and Dash – prices. Similarly, by means of a vector autoregression, Koutmos (2018) argues there is a positive relation between usage of the Bitcoin network and its financial returns. Nonetheless, when comparing the bidirectional linkages between returns and transaction activity, the contribution of return shocks to transaction activity is quantitatively larger in magnitude. A similar result was found by Civitarese (2018a), that found the same feedback relation between prices and number of wallets and through cointegration tests rejected long-term relations between prices and number of wallets, unique addresses, and transactions.

Nonetheless, there is plenty of evidence about other sources of value in Bitcoin and other cryptoassets. The first element is role of pure hype: Dastgir et al. (2018) has found extreme variations in Bitcoin prices can be forecasted with Google Trends data. This results resonates with previous research by Kristoufek (2013) and Polasik et al. (2015), that used Wikipedia and Online News as additional data sources in order to verify attention to the cryptosset is a relevant predictor for prices. This is frequent in other assets that are used as a store of value; for instance, Bialkowski et al. (2015) show that the gold prices from 1975 to 2013 were moving along European crises, as gold represents a safe haven in times of crises. Bitcoin is associated to economic uncertainty as well (Demir et al. 2018), suggesting its prices are affected by demand factor as well.

Another issue, unfortunately very often ignored due to the lack of proxies, is the potential of technology: Wang and Vergne (2017) used panel data analyses to argue technological development is a cause for price increases while buzz around cryptocurrencies is not. This test was possible by using a proxy for technical development by CoinGecko and a measure for looks regarding cryptocurrencies and negative words such as "scam", "hacks" and "Ponzi". Both variables might be criticized as the technical development index is not disclosed and is based on information by GitHub – the weights might influence the returns – and not all FUDs are caused by hacks or generalized mistrust in the coin, but, as we will see, they might be caused by technical failures in specific moments of a cryptoasset history.

2.2. *Market Efficiency, Bubbles and Cryptoassets Prices*

Along with the uncertainty about real source of values on Bitcoin prices, academics raise many questions about the efficiency of the market. The weak market efficiency – predictability using past public information – is discussed by several authors for cryptoassets market. The literature is focused in Bitcoin, but recently research in cryptocurrencies is also conducted.

Regarding Bitcoin, Urquhart (2016) argues it is inefficient; nonetheless, in recent

samples (2013-2016) it is getting more efficient. Analogously, Bariviera (2017) argues the market efficiency of Bitcoin is increasing by using long-memory estimation techniques. Despite these initial results, Nadarajah and Chu (2017) has shown that a simple transformation of Bitcoin prices lead to a form able to pass weak efficiency tests. In this sense, Bitcoin was ever efficient. A similar result was built by Tiwari et al. (2018): Bitcoin was usually efficient despite some periods in 2013 and 2016. Jiang, Nie, and Ruan (2018) provides a counterpoint to these previous studies. Through rolling window estimates of long-memory based on the generalized Hurst Exponent with a block bootstrap procedure, these authors relate Bitcoin was never efficient from 2010 to 2017; more importantly, it is not getting more efficient.

Despite the huge debate over the weak form of market efficiency in Bitcoin, Vidal-Tomás and Ibañez (2018) tested the semi-strong efficiency regarding the impact of news in Bitcoin. Once more the Bitcoin market is argued to be inefficient: from the point of view of monetary policy events there were no responses. It is becoming more efficient in relation to its own events due to an increased attention of investors. However, this efficiency is not clear as it is not possible to find positive responses to positive news. Only bad news affect prices, thus it is not possible to affirm that the Bitcoin market is completely efficient even when examining its own news.

cryptocurrencies are not different. Charfeddine and Maouchi (2018) uses tests robust to structural breaks to investigate the long-range dependency of Bitcoin, Ethereum, Ripple and Litecoin from 2013 (2015 for Ethereum) to January 2018. All volatilities suffer from long-range dependency and the returns of all cryptocurrencies besides Ethereum are not efficient. In a paper focusing on the reasons for efficiency, Brauneis and Mestel (2018) use an index based on the p-value of several market efficiency metrics to check address whether the Garman/Klass volatility, Amihuds illiquidity measure, the Corwin/Schultz spread estimator, turnover ratio, log-dollar volume and log-market capitalization cause efficiency. Through a FGLS regression, the authors find the most relevant variables are liquidity (illiquidity) and market capitalization of the cryptoasset.

This apparently inefficient market is also affected by other phenomena, such as manipulation by large investors and players. Gandal et al. (2018) argue that, along with informed trading, there was direct manipulation of Bitcoin Prices in the collapse of Mt.Gox – the largest exchange in the cryptomarket by 2013. More recently, even with evidence that the market is getting more efficient, another huge manipulation at the exchange level was detected. Griffin and Shams (2018) suggest manipulations through Tether prices. Tether is a stable coin – it pairs 1 to 1 with dollar – issued by a company related to the exchange Bitfinex. As one could expect due to this clear conflict of interest, there is evidence of market manipulation though timed liquidity injections.

Among with these manipulation related to ”whales” and exchanges, cryptocurrency markets are also subject to informed trading. Feng, Wang, and Zhang (2017) used an indicador of informed trading and 42 unexpected events to identify profit by private information, at the cost of other uninformed market participants losses. The authors also studied the timing of informed trades: informed traders prefer to build their positions two days before large positive events and one day before large negative events. Using this strategy, the potential for profit is considerable.

The role of information in Bitcoin is not negligible: it is possible to see both information flows are acting in an unexpected inefficient way – such as the negative news by Vidal-Tomás and Ibañez (2018) - or generating abnormal trading movements (e.g., (Feng, Wang, and Zhang 2017)). To address the impact of information flows regarding

cryptocurrencies is an important topic for research, but still without deeper investigations. An interesting exception is given by Li et al. (2018), which used a trading model based on a Gradient Boost algorithm for predicting the prices of ZClassic, a small-cap cryptocurrency, using sentiment data from Twitter.

Finally, in light of all these inefficiencies and periods of vertiginous price increases, there are some accusations of bubble processes. The evidences of bubbles are not scarce: using a fundamental pricing model, Corbet, Lucey, and Yarovaya (2017) revealed that both Bitcoin and Ethereum have passed through bubble processes. Analogously, Wheatley et al. (2018) use an ecological equation used to predict a "noiseless Metcalfe relation" to detect periodically exploding bubbles. As such, a not so small sample is necessary to capture different phases of the market, but not so large as to take an inconsolided market picture.

2.3. *Event Selection*

In this section, a justification for selecting the FUD cases is done and a brief recap of the these episodes is presented. The main reason for adopting recent FUDs is the consolidation of market. For instance, Ethereum, the largest alternative cryptocurrency, had failures in its pioneer project "The DAO" in 2016 that led to trust shocks in this platform. Nonetheless, Ethereum is the first smart contract platform to be relevant: to build a counterfactual to it is complicated. The recent cryptoecosystem has more options for such task. As such, we use three criteria for selecting FUDs: for liquidity, recency and relevance sake, we analyze top 10 tokens that respond to clear critical failures found since 2017.

To define critical failures is a fundamental task in this paper. Whilst the NEO FUD indeed is based on a shutdown of the blockchain, IOTA FUD is somewhat weaker, for instance, as it was simply a possibility of attack found by researchers at MIT. Nonetheless, the attack was possibly serious and its presence casted doubt on the technology of IOTA (the Tangle Network). A more recent, and more powerful, attack on IOTA – based on a misunderstanding about a partnership with Microsoft – was not considered, as it deals less with the current technology and more to a commercial issue and the objective of this paper is to study the impact of technical reviews of technological failures.

Five FUDs were selected: IOTA's Hash Function failure, NEO's blockchain shutdown, two papers regarding Monero's 0-mixin de-annonymization failure and the EOS launch delay. A brief historical recap of such events is exhibited in this section in order to reveal they might be used as exogenous events regarding the interaction between technology and buzz.

2.3.1. IOTA Code Failure

IOTA is a cryptocurrency based on an alternative distributed public ledger called Tangle. Its objective is to solve scalability issues and reduce fees prices present in the blockchain technology. The technology is not yet decentralized and has applications focused on a single market (IoT), but attracted several investors and quickly had a top market capitalization. More importantly, the implementation counts with idiosyncratic characteristics – it is written in Java, its logic is balanced tertiary, not binary and it counts with a custom non-standard hash functions – that have lead to mistrust by several experts.

The hash function issue is particularly critical as, if it is indeed flawed, it would allow

for textbook attacks to happen. In August 2017, MIT researchers have found this kind of failure in IOTA code. Quickly the code was "corrected", but 7th September Dr. Neha Narula, a MIT researcher, released a critical assessment of IOTA technologies. Whilst this review was mainly founded over a solved issue, it was important as it attacked one of the core elements of IOTA as a cryptocurrency: it cryptographical security. The hash function of IOTA – that, according to MIT, was still used in IOTA's code after the fix – was compromised and it was not safe to continue using it. After this, MIT research teams continued to criticize the cryptocurrency. Nevertheless, the initial MIT FUD was a very critical opinion piece against IOTA technical capabilities; in this paper, we consider only the initial opinion piece as the dispute between MIT and IOTA foundation continues until today – and in the courts, not only in technical issues.

2.3.2. NEO Blockchain Failures

NEO is a cryptocurrency that intends to compete with Ethereum, the largest cryptocurrency. Both of them are embedded with a Turing-Complete language, thus, more than a currency, they are a platform for (ideally) decentralized applications. This technology suffers from initial problems such as excessive concentration on its foundation, but has interesting properties in its language and, more importantly, it complies with the Chinese government. The market expectation that, sooner or later, China will open itself to public blockchains places NEO as an important cryptocurrency, the 6th in market capitalization.

25th February 2018, the blog Store of Value released a review about technical problems on NEO. They indicated the concentration and that the NEO platform suffered drawbacks when launching applications. The post, called "NEO Is A Multi-Billion Dollar Disaster", revealed as well a 2 hour failure with no apparent reason. This post quickly spread to the cryptocurrency community. A few days later, the blockchain had a similar failure again. A larger website, Bitcoin.com, released a article "NEO Is Either a Raging Success or a Total Disaster" in 3rd May citing the first post. Eric Wall, an analyst, wrote a twitter thread criticizing NEO's implementation of its Byzantine Fault Tolerant consensus algorithm; this was retweeted by Charlie Lee, the creator of Litecoin, the 5th largest cryptocurrency by that time, suggesting a strong word of mouth effect.

2.3.3. First and Second Monero FUD

Monero is the most famous privacy coin, the subset of cryptocurrency focused on anonymity over transactions between users. Therefore, the technology of such asset must be reliable for the main comparative advantage of this cryptocurrency to exist. Its initial technology was inspired on dark pools; in other words, it combined transactions in pools such it was difficult to trace the origins of the money. Its structure evolved over time and new algorithms other than the transactions mixtures were added.

Nonetheless, in April 2017 a paper called "An Empirical Analysis of Linkability in the Monero Blockchain" (Miller et al. 2017) argued it was possible to map the origin of circa 80% of Monero transfers. This analysis was mainly built over a previous failure of Monero: the possibility of transactions with no mixture processing. Quickly the news spread, and a FUD period disrupted. Among the authors of the paper, there was a member of ZCash – a competitor to Monero – as the first author. There was a debate over the validity of the results; nonetheless, the paper had consistent results. Many of the arguments present were acknowledged by Monero in a blog post in 19th April.

Despite the reconnaissance of the paper, the main comment was regarding that it was outdated: by that time, the Monero community had many of the failures appointed already solved as all transactions must pass through mixtures.

This was the first FUD wave this paper would cause to Monero. May 2018, an updated version of the paper was uploaded to ArXiv. This new version had little changes from the initial one and many problems were indeed solved; nonetheless, it suggested there was still possible to trace transactions in Monero due to some path dependency from the times without proper insurance of privacy. The results echoed once more in the cryptoassets community, leading to another FUD.

2.3.4. EOS FUD

EOS was a much antecipated cryptoasset. Its main leader, Dan Larimer, was the responsible for two credible decentralized projects before – the decentralized exchange Bitshares and the decentralized social network STEEM – and had organized the largest ICO in history to fund his new project. The ICO was organized using periodical auctions of an ERC20 Token placed in Ethereum network that would be traded by the main EOS token in the launch of the EOS mainnet. The auctions would end in 1st June 2018, and the network was supposed to be launched in the end of this day.

Nonetheless, several facts delayed the launch of the EOS network. First, a bounty reward program for finding bugs was launched only a week before and several problems were discovered. At the same time, a (group of) hackers stole the EOS investors email database and launched a phishing scheme that stole several EOS tokens. More importantly: fundamental issues of the EOS network such the RAM for applications – an essential problem for a platform that intends to be a decentralized computer – were not solved by the time and had a non-negligible cost to launch. These events postponed the launch of the platform, increasing uncertainty about the event. Finally, 9th June the mainnet was launched and a poll to decide the block producers was conducted. After the poll an additional emission of 260.000 dollars in EOS tokens was issued to compensate the RAM requirements in a manoeuvre reported even by the Wall Street Journal, and the main net was launched.

After this initial problem, there was another question to be settled: the governance of the network. A constitution was drafted by the Block.One team – the company responsible for developing EOS – and, in one hand, it faced criticisms because a human constitution drafted alone by a company that has a major stake on the network is a strong signal of concentration; in another front, the presence of a human component – an arbitrage chamber – added uncertainty in an environment where other projects – e.g., Ethereum – are prone to a more cypherpunk (code is law) or democratic (constant polls) approach.

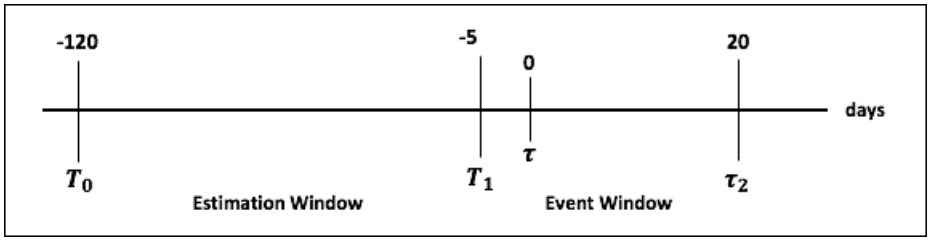
Less than a month after the main net release, 19th of June, this arbitration chamber failed to handle a series of alleged security breaches and Block Producers to took unilateral action and froze the endangered accounts. This was the culmination of a process that took almost two weeks, as this crisis began 17th June with the an unanimous decision of Block Producer. Of course, these producers were accused of power abuse. This might be considered a blockchain failure, as an institution of "governance of the structure" (De Filippi and Loveluck 2016) was insufficient. Nonetheless, 9th July there was a literal blockchain failure due to RAM issues. This fact ends the huge succession of EOS FUDs.

3. Event Studies

Based on the previous incidents, we test their impact on returns using the Event Study methodology. A counterfactual for cryptocurrencies is devised using the returns of Bitcoin and Ethereum, the first cryptocurrency and the largest platform. There is an index for cryptocurrencies - CRIX (Trimborn and Härdle 2016) -, nonetheless we prefered to use data from the same source and to analyze how largest currencies influence the smaller ones. The data was gathered from the Coin Market Cap [1].

The event day is defined as the day an expert releases a public statement about a current or future potential platform/blockchain failure. Based on the cases discussed in Appendix A, six FUDs are mapped. These FUDs may be due to failures on the blockchain, academic papers with high impact on the community. The event window is composed of 26 days, comprised of 5 pre-event days, the event day, and 20 post-event days. Figure 1 illustrates the timeline of the event study.

Figure 1. Timeline of the event study



4. Results

The result of the counterfactual regressions are disposed in table 4. we did not used the complete data to allow for data to adjust to more recent trends in the counterfactual. All regressions use Newey-West robust covariance matrix to adjust to autocorrelated errors.

Table 1. Counterfactual regressions using the returns of NEO, IOTA, Bitcoin and Ether.

	Dependent variable:				
	NEO	EOS	Monero I	Monero II	IOTA
Bitcoin	0.100	0.559*	0.633***	0.612***	0.947***
	(0.088)	(0.225)	(0.158)	(0.141)	(0.280)
Ethereum	0.939***	0.545*	0.376***	0.539***	0.512*
	(0.106)	(0.218)	(0.065)	(0.109)	(0.221)
Constant	0.005	0.006	0.000	0.002	-0.004
	(0.005)	(0.006)	(0.004)	(0.003)	(0.010)
Observations	120	120	120	120	80
R-squared:	0.451	0.445	0.442	0.641	0.371
Adjusted R-squared:	0.442	0.436	0.432	0.635	0.355

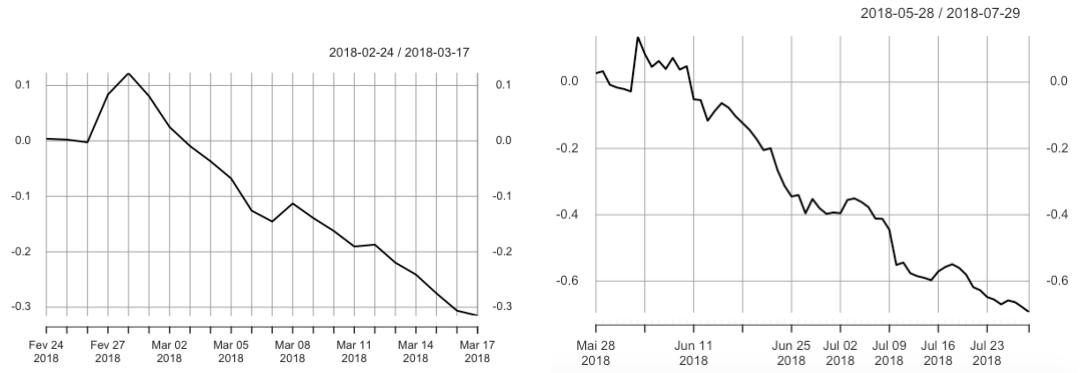
Note: Standard errors in parentheses: $^{*}(p < 0.10)$; $^{**}(p < 0.05)$; $^{***}(p < 0.01)$

It is possible to see both BTC and ETH are relevant to explain the other cryptocur-

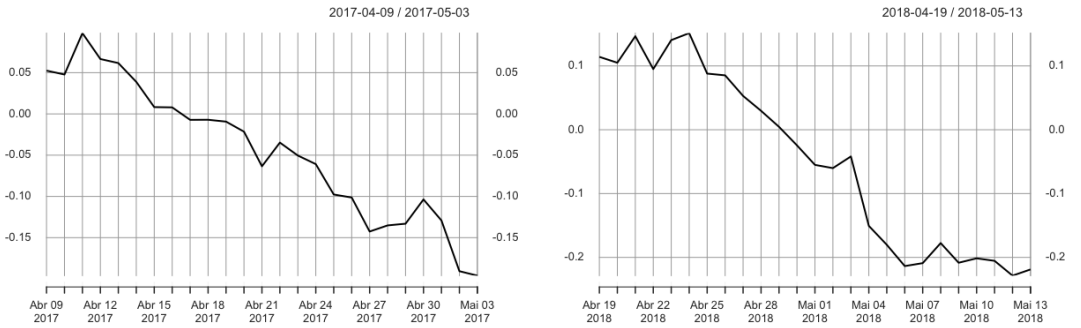
[1] Available https://coinmarketcap.com/

rencies returns. Nonetheless, BTC is not useful explaining NEO returns, suggesting smart contracts platforms have different financial characteristics than pure store of value/mean-of-payments cryptoassets. However, this is not robust: a specification using one year of data before the NEO FUD had a significant result for both BTC and ETH, but a smaller R-squared. This alternative specification was used, among others, as a robustness test for the creation of counterfactuals.

The events were analyzed by creating counterfactuals with the predicted values of the regressions in table 4 – excluding BTC in NEO's case – and following the recommendations by MacKinlay (1997). The event window is 21 days after the release of the information. The counterfactual returns are displayed in figure 1, while the cumulative abnormal returns average, standard deviation and t-statistic are displayed in table 2. It is possible to see both FUDs have a negative impact significant at 1%. This result is robust to other counterfactual specifications.



(a) NEO returns and the calculated counterfactual. (b) EOS returns and the calculated counterfactual.



(c) Monero I returns and the calculated counterfactual.

(d) Monero II returns and the calculated counterfactual.

Figure 2. These plots exhibit the counterfactual and the returns used to calculate the abnormal returns. NEO is clearly below the counterfactual, whilst IOTA has a less pronounced result.

By analyzing the graphs, it is possible to see both cases selected have the abnormal returns deviations in the beginning of the event window, with the counterfactual converging to the realized returns. This suggests the counterfactual are well specified and the impact of FUDs is a short-term one. It is important to highlight that, despite the shocks dissipate over time, they are still significant, with FUDs being relevant to cryptocurrencies pricing.

Table 2. Cumulative Abnormal Return

Crypto	Type of event	Event date	CAR	SE(CAR)	T-test
NEO	Blockchain failure	25/02/18	-0.315	0.033	-9.580***
EOS[1]	Blockchain failure	29/05/18	-0.693	0.036	-18.900***
Monero I	Paper	13/04/17	-0.196	0.027	-7.160***
Monero II	Paper	23/04/18	-0.219	0.042	-5.190***
IOTA	Paper	07/09/17	0.0404	0.0729	0.554

The t-statistics is based on two-tailed test, *($p < 0.10$); **($p < 0.05$); ***($p < 0.01$)
[1]We extended the window for two months instead of 21 days due to the nature of sequential FUDs compromising what we call The EOS Launch FUD

5. Conclusion

In this paper, we studied a determinant to the semi-strong form of market efficiency: the usage of public information in cryptocurrencies price variations. It is possible to see that the release of information regarding code failures brings negative abnormal returns as expected. The issuance of such news are quickly explored by market participants, revealing alternative cryptocurrencies are possibly consolidating as a viable asset. This is in line with the results by Wang and Vergne (2017).

The results reported here are good news for investors focused in anticipating technology shocks. A good asset research team can uncover some problems by simply checking the blockchain data – as in NEO's case – and avoid loses. In such case, practitioners must study not only the statistical properties or quantitative pricing mechanisms, but the technological aspects as well. The results in this paper highlight this challenge when studying this new class of investments.

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