Digital Coins Eco-System: Analyzing the Network of Prices and Volume

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Abstract The study provides an extent analysis of digital coins eco-system from November 2017 to October 2018 based on an hourly time interval. I focus on correlation among these coins and the Bitcoin as Bitcoin to become a mainstream investable asset class, thus studying these properties is necessary. The findings show that bitcoin price and volume is not correlated with most of the traded digital coins while several digital coins are highly and significantly correlated with other coins, This has implications for risk management and financial engineering (such as bitcoin derivatives)-both from an investor’s as well as from a regulator’s point of view.

Keywords: Bitcoin, digital currencies, risk management

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1. Introduction

The most famous cryptocurrency, Bitcoin, was created by an unidentified programmer under the name of Satoshi Nakamoto, introduced it on 31 October, 2008 and released as open-source software in 2009 [1]. Bitcoin is the first decentralized digital currency and is a part of a growing family of more than 720 cryptocurrencies. The second and third largest cryptocurrencies are Ethereum and Ripple, representing 7.6% and 2.4% of the market. The top 10 of those 720 cryptocurrencies (Bitcoin, Ethereum, Ripple, Litecoin, Ethereum Classic, Monero, Dash, Augur, MaidSafeCoin, Waves) represent about 95% of the market.

In this paper, I examine whether bitcoin is connected with other digital coins movement and to what extent are the correlations among digital coins. I argue that bitcoin does not behave like other digital coins, while digital coins other than Bitcoin do correlate with each other.

In order to explore this eco-system of digital coins I analyze connection among digital coins on an hourly basis from November 2017 to October 2018.

1.1. Literature Overview

The literature on Bitcoin was initially dominated by studies on the safety, ethical and legal aspects of Bitcoin. Recently, some literature has examined Bitcoin from an economic viewpoint. Selgin [2] argued that investors have employed Bitcoin as currency as well as for investment purposes, although, they claimed that Bitcoin should be seen as a speculative commodity rather than a currency. Dwyer [3] finds that the average monthly volatility of Bitcoin is higher than that for gold or a set of foreign currencies, and the lowest monthly volatilities for Bitcoin are less than the highest monthly volatility for gold and currencies.

Cheah and Fry [4] argue that if Bitcoin were a true unit or account, or a form of store of value, it would not display such volatility expressed by bubbles and crashes. Cheung et al [5] show the existence of bubbles in the bitcoin market over the period and find a number of short-lived bubbles but also three huge bubbles, the last of which led to the demise of the Mt Gox exchange. Brière et al [6] show that Bitcoin offers significant diversification benefits for investors while Dyhrberg [7] show that Bitcoin has similar hedging capabilities as gold and the dollar, and as such can be employed for risk management.

Fry and Cheah [8] develop a model to reveal that Bitcoin and Ripple are characterized by negative bubbles. Bouri et al. [9] and [10] scrutinize hedge and safe haven properties of Bitcoin vis-à-vis several stock, bonds and currency indices around the world. Its main finding is that the cryptocurrency is only useful as a diversifier device, but not as a hedge instrument. Finally, Balcilar et al. [9] detect nonlinearities in the return-volume relationship, which allows for return prediction. None of these studies analyzed, as to our knowledge, the correlation among this ’basket of coins’.

1.2. Hypotheses

We assert that the correlation between and among digital coins will be significantly high. Therefore, we hypothesize:

H1 (correlation): An upward in prices and volume in one digital coin will create a positive relation in other digital coins.

H2 (Bitcoin correlation): An upward in prices and volume in Bitcoin will create a positive relation in other digital coins.
2. Data and Methodology

To examine how digital coins behavior is related between different coins we conducted a correlation test on prices, as well as on volumes to measure degree of relationship. We gathered a wide sample of 16 digital coins from November 2017 until October 2018 from Binace, a well-known cryptocurrency stock exchange (https://www.binance.com/en). All data consist of prices and volume on an hourly base, creating a sample of 68,258 observations per digital coin and approximately 1 million observations.

Our methodology is based the Pearson product-moment correlation coefficient, also known as $r$, $R$, or Pearson's $r$, is a measure of the strength and direction of the linear relationship between two variables that is defined as the covariance of the variables divided by the product of their standard deviations. This is the best known and most commonly used type of correlation coefficient. I check correlation coefficients that are over 0.5, which means that the volume is strongly correlated between the digital coins.

Below is the legend of our digital coins sample:

| Name     | ID |
|----------|----|
| Bitcoin  | 1  |
| Bitcoin-Cash | 2 |
| Cardano  | 3  |
| Dash     | 4  |
| EOS      | 5  |
| Ethereum | 6  |
| Kyber-Network | 7 |
| Litecoin | 8  |
| Monero   | 9  |
| NEO      | 10 |
| Ripple   | 11 |
| Storm    | 12 |
| TRON     | 13 |
| Verge    | 14 |
| Walton   | 15 |
| ZenCash  | 16 |

Table 1. Correlation of 16 digital coins prices, November 2017-October 2018 (intra-day)

| price_d1 | price_d2 | price_d3 | price_d4 | price_d5 | price_d6 | price_d7 | price_d8 |
|----------|----------|----------|----------|----------|----------|----------|----------|
| price_d1 | 1        |          |          |          |          |          |          |
| price_d2 | 0.0418   | 1        |          |          |          |          |          |
| price_d3 | 0.0408   | 0.891*** | 1        |          |          |          |          |
| price_d4 | -0.00535 | 0.801*** | 0.860*** | 1        |          |          |          |
| price_d5 | 0.0427   | 0.862*** | 0.793*** | 0.754*** | 1        |          |          |
| price_d6 | 0.00319  | 0.755*** | 0.732*** | 0.836*** | 0.845*** | 1        |          |
| price_d7 | -0.0101  | 0.843*** | 0.894*** | 0.913*** | 0.809*** | 0.840*** | 1        |
| price_d8 | 0.0166   | 0.915*** | 0.863*** | 0.839*** | 0.912*** | 0.883*** | 0.887*** | 1      |
| price_d9 | 0.0116   | 0.650*** | 0.754*** | 0.865*** | 0.642*** | 0.774*** | 0.813*** | 0.692*** |
| price_d10| 0.00833  | 0.828*** | 0.881*** | 0.889*** | 0.848*** | 0.877*** | 0.942*** | 0.907*** |
| price_d11| -0.00947 | 0.856*** | 0.804*** | 0.837*** | 0.918*** | 0.914*** | 0.852*** | 0.932*** |
| price_d12| 0.0106   | 0.870*** | 0.925*** | 0.920*** | 0.829*** | 0.843*** | 0.959*** | 0.902*** |
| price_d13| 0.0331   | 0.914*** | 0.897*** | 0.858*** | 0.925*** | 0.866*** | 0.901*** | 0.949*** |
| price_d14| 0.0195   | 0.870*** | 0.934*** | 0.891*** | 0.729*** | 0.719*** | 0.923*** | 0.832*** |
| price_d15| 0.00528  | 0.772*** | 0.750*** | 0.841*** | 0.858*** | 0.929*** | 0.865*** | 0.893*** |
| price_d16| 0.0629*  | 0.0903***| 0.0317   | -0.166***| 0.0237   | -0.147***| -0.0255  | 0.0524* |

| price_d9 | price_d10| price_d11| price_d12| price_d13| price_d14| price_d15| price_d16|
|----------|----------|----------|----------|----------|----------|----------|----------|
| price_d1 | 0.799*** | 1        |          |          |          |          |          |
| price_d2 |          | 0.729*** | 0.878*** | 1        |          |          |          |
| price_d3 |          |          | 0.830*** | 0.954*** | 0.872*** | 1        |          |
| price_d4 |          |          |          | 0.744*** | 0.918*** | 0.934*** | 0.927*** | 1      |
| price_d5 |          |          |          |          | 0.800*** | 0.881*** | 0.773*** | 0.942*** | 1      |
| price_d6 |          |          |          |          |          | 0.748*** | 0.895*** | 0.923*** | 0.876*** | 0.888*** | 0.758*** | 1      |
| price_d7 |          |          |          |          |          |          | -0.302***| -0.006   | -0.100***| -0.0352  | -0.00348| -0.0166  | -0.123*** | 1      |

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. 
Table 2. Correlation of 16 digital coins volume, November 2017-October 2018

|          | volume_d1 | volume_d2 | volume_d3 | volume_d4 | volume_d5 | volume_d6 | volume_d7 | volume_d8 |
|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| volume_d1| 1         |           |           |           |           |           |           |           |
| volume_d2| 0.849***  | 1         |           |           |           |           |           |           |
| volume_d3| 0.310***  | 0.674***  | 1         |           |           |           |           |           |
| volume_d4| 0.944***  | 0.949***  | 0.415***  | 1         |           |           |           |           |
| volume_d5| 0.911***  | 0.991***  | 0.620***  | 0.969***  | 1         |           |           |           |
| volume_d6| 0.852***  | 0.880***  | 0.730***  | 0.811***  | 0.911***  | 1         |           |           |
| volume_d7| 0.861***  | 0.990***  | 0.576***  | 0.973***  | 0.982***  | 0.821***  | 1         |           |
| volume_d8| 0.875***  | 0.998***  | 0.657***  | 0.958***  | 0.997***  | 0.897***  | 0.988***  | 1         |
| volume_d9| 0.910***  | 0.977***  | 0.503***  | 0.993***  | 0.984***  | 0.826***  | 0.993***  | 0.981***  |
| volume_d10| 0.234*** | 0.630***  | 0.996***  | 0.357***  | 0.566***  | 0.668***  | 0.532***  | 0.610***  |
| volume_d11| 0.826*** | 0.987***  | 0.763***  | 0.904***  | 0.980***  | 0.931***  | 0.956***  | 0.988***  |
| volume_d12| 0.187*** | 0.583***  | 0.992***  | 0.302***  | 0.519***  | 0.641***  | 0.479***  | 0.562***  |
| volume_d13| 0.424*** | 0.717***  | 0.987***  | 0.484***  | 0.683***  | 0.821***  | 0.617***  | 0.709***  |
| volume_d14| 0.403*** | 0.703***  | 0.989***  | 0.465***  | 0.667***  | 0.808***  | 0.601***  | 0.694***  |
| volume_d15| 0.686*** | 0.961***  | 0.836***  | 0.827***  | 0.924***  | 0.847***  | 0.927***  | 0.949***  |
| volume_d16| 0.672*** | 0.942***  | 0.863***  | 0.797***  | 0.908***  | 0.865***  | 0.898***  | 0.932***  |

3. Results

Table 1 and Table 2 show the results of the correlation test on price and volume, respectively. As show in Table 1, most of the prices are positive and statistically significant correlate between the different digital coins. All the digital coins, except Bitcoin and ZenCash, are strongly correlated in the price, with a positive and significant correlation. Bitcoin is positively correlated with most of the coins, yet its only significant correlate with ZenCash. ZenCash is positively and significant correlate with Bitcoin, Bitcoin-Cash and Litecoin, but has a negative and significant correlation with Ethereum, Monero, Ripple, Walton. EOS and Ripple are highly correlated in a way one can see an investment in EOS as a way of investment in Ripple as shows in Table 1.

Data in Table 2 we can see that all coins have a positive and significant correlation in their volume. Most of the correlation coefficients are over 0.5, which means that the volume is strongly correlated between the digital coins. That is supports our H1 and H2 hypothesis.

The table below shows simple correlation of the percentage changes in daily exchange rates for pairs of currencies and assets like gold, with all exchange rates measured against the U.S dollar. Correlations are calculated for the same period as calculated above, i.e. November 2017 until October 2018.

Table 3. A correlation of Bitcoin and other daily exchange rates currencies

|          | EUR | IPY | CUF | GBP | Gold | Bitcoin |
|----------|-----|-----|-----|-----|------|---------|
| EUR      | 1.00| 0.18| 0.61| 0.64| 0.20 | -0.05   |
| IPY      | 1.00| 0.33| 0.20| 0.07| 0.01 |         |
| CUF      | 1.00| 0.42| 0.19| -0.04|     |         |
| GBP      | 1.00| 0.21| -0.02|     |     |         |
| Gold     | 1.00| -0.06|     |     |     |         |
| Bitcoin  | 1.00|     |     |     |     |         |

*p < 0.05, **p < 0.01, ***p < 0.001.
4. Discussion

In this paper, I studied whether there is an eco-system of digital coins; if a movement in one digital coin will create an effect and to explore rather Bitcoin, the largest digital coin in value, is also correlated with other digital coins and to what extent.

To this purpose, I analyze the correlation among 16 digital coins from November 2017 to October 2018 based on an hourly interval of time. We find, as far as we know for the first time, a correlation in between and among several digital coins. To wit, we find that all digital coins, except Bitcoin and ZenCash, are strongly correlated in price and volume, with a positive and significant correlation, supporting our H1 hypothesis. We also find that Bitcoin is positively correlated with most of the coins, yet its only significant correlate with ZenCash, supporting our H2 hypothesis.

I assert that high volatility of Bitcoin in related to other stock exchange currencies lead to the non-correlation we show. In related to other small digital coins Bitcoin seems an island of stability, thus we find lower correlation between Bitcoin and most of the other digital coins.

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