

# Asset Pricing Analysis of 18 Cryptocurrencies

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## ABSTRACT

Abstract— This paper identifies three factor pricing model for cryptocurrency, which are related to cryptocurrency's market return, size (market capitalization), and network-value-to transaction ratio (NVT ratio). Using 18 cryptocurrencies over the period from 01 January 2016 to 25 September 2019, we find that small cryptocurrencies have higher returns than big cryptocurrencies and results show that most cryptocurrencies have significant exposures to proposed three factors pricing model, which means the proposed three factors pricing model can explain average cryptocurrency excess return well.

**Keywords**— Cryptocurrency, Asset Pricing, 3 Factors Model

## 1. INTRODUCTION

Cryptocurrency has been developing rapidly since 2009. Nowadays, there are more than 4,000 types of cryptocurrencies. Bitcoin is the largest cryptocurrency with \$151,331,182,777 market capitalization (as September 25<sup>th</sup> 2019). As Bitcoin's trading volume increase from time to time, cryptocurrency market has received attention from the government, financial industry, and media (Liu, 2018).

Government and the economist have been trying to explain what is the economic context of cryptocurrency. Lots of research have been done to answer that question. In 2014, Glasser., et al investigate about the use of Bitcoin. The purpose of research is giving empirical insights on users' intentions regarding Bitcoin, whether the users use Bitcoin as an alternative payment system or use Bitcoin as speculative investment. The results show that most of Bitcoin users tend to use Bitcoin as a speculative investment and have low intention to use Bitcoin for paying goods and services.

Users treat cryptocurrency as speculative asset, so that researcher called cryptocurrency as a new class of assets, while stocks, obligation, and so forth referred as traditional assets (Pelster., et al, 2019). Cryptocurrency, especially Bitcoin, can be referred as highly speculative asset because of high volatility and unstable price.

Most of the countries in the world prohibits cryptocurrency as an alternative payment system but can be traded as an asset. Cryptocurrency is a whole new world in economics and financial industry, therefore there is lack of cryptocurrency's fundamental analysis.

There are lots of research that analyze asset pricing of cryptocurrency using the fundamental analysis of stocks, but this is not correct. Cryptocurrency and stocks have different characteristics therefore to analyze the asset pricing of

cryptocurrency should be adjust to cryptocurrency's characteristics. For this reason, the purpose of this research is to analyze the asset pricing of cryptocurrency which will be adjusted to cryptocurrency's characteristics.

This research will adopt the asset pricing analysis from Fama-French 3 factors model. The three factors of Fama-French 3 factors model are excess market return ( $r_m - r_f$ ), size (SMB), and book-to-market ratio (HML). This research also will use three factors model, which are related to excess market return of cryptocurrency ( $r_m - r_f$ ), size (SMB), and network-value-to transaction ratio (LMH).

This research uses 18 cryptocurrencies which selected from top 100 cryptocurrencies with the highest market capitalization as the research object. The results of this research can be an information for the cryptocurrencies investors to know about asset pricing analysis or fundamental analysis of cryptocurrency.

## 2. LITERATURE REVIEW

### 2.1. Cryptocurrency

Cryptocurrency is peer-to-peer digital cash systems which allow online payment to be sent directly from one party to another party without intermediaries or central bank (Corbet., et al, 2019). Unlike another financial assets, cryptocurrency does not have association with the authorities, does not have a physical asset, and the record is forever in the system called blockchain.

The value of cryptocurrency is not based on tangible asset, a firm's performance or countries economy, but it is based on the security of an algorithm which is able to trace all transaction (Corbet., et al, 2019).

## 2.2. Asset Pricing Model

There are several asset pricing measurements that has been used as fundamental analysis for stocks, such as capital asset pricing model (CAPM), Fama-French 3 factors model, Fama-French 5 factors model, and so on. Even though cryptocurrency referred as asset but fundamentally it is different from stocks (Liu., et al, 2019).

This research will adopt the asset pricing analysis from Fama-French 3 factors model and then will be adjusted to cryptocurrency's characteristics. This following equation is Fama-French 3 factors model (Fama and French, 1993):

$$r_{it} - r_{ft} = \alpha + \beta_1(r_{mt} - r_{ft}) + \beta_{SMB} * SMB_t + \beta_{HML} * HML_t + \epsilon_{it} \quad (1)$$

Where  $r_{it}$  is the return of portfolio;  $r_{ft}$  is the risk free rate;  $\beta$  is factor's coefficient;  $r_{mt} - r_{ft}$  is the market risk premium;  $SMB_t$  is return of small companies over large compnaies;  $HML_t$  is return of value stocks over growth stocks.

From Fama-French 3 factors model above, the asset pricing model for this research will be:

$$r_{it} - r_{ft} = \alpha + \beta_1(r_{mt} - r_{ft}) + \beta_{SMB} * SMB_t + \beta_{LMH} * LMH_t + \epsilon_{it} \quad (2)$$

Where  $r_{it} - r_{ft}$  is the excess return of cryptocurrency;  $r_{ft}$  is the risk free rate;  $\beta$  is factor's coefficient;  $r_{mt} - r_{ft}$  is the market risk premium;  $SMB_t$  is return of small cryptocurrency over large cryptocurrency;  $LMH_t$  is return of low ratio over high ratio.

Cryptocurrency is a virtual asset which does not have book value. HML in Fama-French 3 factors model is based on book-to-market ratio therefore it can not be used in asset pricing model for cryptocurrency. So, HML on this research will be using network-value-to transaction ratio (NVT). We are using LMH because the result of high NVT ratio is interpreted as high sentiment and low NVT ratio is interpreted as low sentiment.

Shen, Urquhart and Wang (2019) investigate about three factors pricing model for cryptocurrencies. Three factors which relate to their research are excess market return, size, and reversal factor. The results show that 3 factors model can explained average return better than cryptocurrency capital asset pricing model (C-CAPM).

Liu, Liang and Cui (2019) also investigate about pricing model for cryptocurrencies. The three factors on their research are related to excess market return, size, and momentum. The results show that these three factors can explained average return of cryptocurrencies better than the 1 factor model. The researchers explained that the complexity of cryptocurrency market is far from fully explored, so their analysis could be used as a benchmark to identify other additional factors.

## 2.3. Hypothesis

We want to see if the independent variable, which are the excess market return, size, and NVT ratio, have significant effect on the dependent variable which is the excess return of cryptocurrency. The hypotheses of this research are:

H1:  $r_{mt}$  has significant effect on the estimation excess return of cryptocurrency  $i$ .

H2:  $SMB$  has significant effect on the estimation excess return of cryptocurrency  $i$ .

H3:  $LMH$  has significant effect on the estimation excess return of cryptocurrency  $i$ .

## 3. METHODOLOGY

### 3.1. Research Object

The research object are 18 cryptocurrencies which are selected from 100 top cryptocurrencies with the highest market capitalization as September 25<sup>th</sup> 2019 and have data over the period January 1<sup>st</sup> 2016 to September 25<sup>th</sup> 2019. The selected cryptocurrencies are Bitcoin, Ethereum, XRP, Tether, Litecoin, Stellar, Monero, DASH, NEM, Dogecoin, DigiByte, Bytecoin, MaidSafeCoin, Bitshares, Monacoin, Siacoin, Verge, and Reddcoin.

This research uses time-series regression to see the level of significance of independent variable to dependent variable.

Table 1. Research object

No.	Cryptocurrency	Market Capitalization (\$)
1	Bitcoin	152,404,005,091
2	Ethereum	18,438,188,568
3	XRP	10,616,698,451
4	Tether	4,135,771,272
5	Litecoin	3,651,789,616
6	Stellar	1,146,369,310
7	Monero	1,031,288,247
8	DASH	662,008,601
9	NEM	367,359,088
10	Dogecoin	266,601,413
11	DigiByte	87,264,231
12	Bytecoin	77,672,743
13	MaidSafeCoin	72,812,265
14	BitShares	71,846,410
15	MonaCoin	71,248,796
16	Siacoin	65,363,274
17	Verge	54,360,095
18	Reddcoin	30,963,529

### 3.2. Data

Data on this research will be collected from <https://coinmarketcap.com/> website, risk-free rate data will be collected from <https://www.treasury.gov/> website, and rate of

market return data will be collected from <https://cci30.com> website.

### 3.3. Equations

Following are equations of risk-free rate, rate of market return, SMB, and LMH

$$r_f = (\text{daily treasury bill rates} / 100) / 365 \quad (3)$$

$$r_m = (\text{close price } CCI_{30_t} - \text{close price } CCI_{30_{t-1}}) / \text{close price } CCI_{30_{t-1}} \quad (4)$$

$$r_m - r_f = \text{cryptocurrency market return} - \text{risk free rate} \quad (5)$$

$$\text{SMB} = \text{daily average return of small cryptocurrency} - \text{daily average return of big cryptocurrency} \quad (6)$$

$$\text{LMH} = \text{daily average return of low cryptocurrency} - \text{daily average return of high cryptocurrency} \quad (7)$$

### 4. RESULTS

Table 2. Time-series regression results

Return of	rmrf	SMB	LMH	Adj. R2	F-value
Bitcoin	0.770 (35.608)***	0.023 (0.879)	0.086 (3.586)***	0.665	902.243
Ethereum	1.050 (31.408)***	0.012 (0.223)	0.182 (3.347)***	0.495	446.123
XRP	1.027 (14.507)***	-0.553 (-3.104)***	-0.648 (-3.420)***	0.364	260.819
Tether	0.003 (0.497)	-0.006 (-1.119)	-0.002 (-0.277)	0.000065	1.030
Litecoin	1.007 (21.094)***	-0.108 (-2.381)**	0.089 (1.856)*	0.482	423.201
Stellar	1.104 (23.635)***	-0.461 (-3.605)***	-0.695 (-4.180)***	0.378	276.438
Monero	1.056 (28.670)***	-0.085 (-2.443)**	0.118 (2.995)***	0.376	274.200
DASH	0.902 (23.153)***	0.033 (0.585)	0.144 (3.040)***	0.392	293.193
NEM	1.150 (18.643)***	-0.547 (-2.830)***	-0.804 (-3.901)***	0.401	305.188
Dogecoin	0.881 (22.345)***	0.472 (4.758)***	0.123 (1.460)	0.444	363.653
DigiByte	1.051 (21.281)***	1.303 (5.214)***	0.873 (4.097)***	0.466	396.371
Bytecoin	0.824 (6.257)***	1.258 (3.502)***	-1.036 (-2.230)**	0.362	258.559
MaidSafeCoin	0.911 (24.662)***	0.114 (2.258)**	-0.069 (-1.403)	0.371	268.823
BitShares	1.132 (25.919)***	0.383 (4.064)***	0.259 (2.571)**	0.439	355.735
MonaCoin	0.652 (12.515)***	0.139 (1.367)	-0.497 (-3.897)***	0.180	100.336
Siacoin	1.113 (24.839)***	-1.093 (8.062)***	-0.872 (6.099)***	0.494	444.574
Verge	0.752 (9.084)***	1.350 (7.721)***	-1.047 (-4.761)***	0.464	393.287
Reddcoin	0.752 (9.573)***	1.195 (3.899)***	-1.008 (-3.903)***	0.462	389.850

The results show that most cryptocurrencies have exposure to proposed three factors model. Except for tether which is the average excess return does not have exposure to proposed three

factors model. This is because the price of Tether is stable on range \$0.97 to \$1.

The answers of the hypotheses are rmrf and LMH have significant effect on the estimation excess return of Bitcoin but SMB does not significantly effect the estimation excess return of Bitcoin; rmrf and LMH have significant effect on the estimation excess return of Ethereum but SMB does not have significant effect on estimation excess return of Ethereum; rmrf, SMB, and LMH have significant effect on estimation excess return of XRP; rmrf, SMB, and LMH does not have significant effect on estimation excess return of Tether; rmrf, SMB, and LMH have significant effect on estimation excess return of Litecoin; rmrf, SMB, and LMH have significant effect on estimation excess return of Stellar; rmrf, SMB, and LMH have significant effect on estimation excess return of Monero; rmrf and LMH have significant effect on estimation excess return of DASH but SMB does not have significant effect on estimation return of DASH; rmrf, SMB, and LMH have significant effect on estimation excess return of NEM; rmrf and SMB have significant effect on estimation excess return of Dogecoin but LMH does not have significant effect on estimation excess return of Dogecoin; rmrf, SMB, and LMH have significant effect on estimation excess return of DigiByte; rmrf, SMB, and LMH have significant effect on estimation excess return of Bytecoin; rmrf and SMB have significant effect on estimation excess return of MaidSafeCoin but LMH does not have significant effect on estimation excess return of MaidSafeCoin; rmrf, SMB, and LMH have significant effect on estimation excess return of BitShares; rmrf and LMH have significant effect on estimation excess return of MonaCoin but SMB does not have significant effect on estimation excess return of MonaCoin; rmrf, SMB, and LMH have significant effect on estimation excess return of Siacoin; rmrf, SMB, and LMH have significant effect on estimation excess return of Verge; rmrf, SMB, and LMH have significant effect on estimation excess return of Reddcoin.

Table 3. Comparison results between average excess return and asset pricing

Cryptocurrency	Asset Pricing	Average Excess Return	Comparison
1. Bitcoin	0.00293664	0.00294255	0.00000591
2. Ethereum	0.00570216	0.00571523	0.00001307
3. XRP	0.00560355	0.00560063	-0.00000292
4. Tether	-0.00001514	-0.00001501	0.00000013
5. Litecoin	0.00373378	0.00373657	0.00000279
6. Stellar	0.00602944	0.00602285	-0.00000659
7. Monero	0.00588823	0.00589495	0.00000672
8. Dash	0.00399591	0.00399235	-0.00000356
9. NEM	0.00768485	0.00767216	-0.00001269
10. Dogecoin	0.00417110	0.00417167	0.00000056
11. DigiByte	0.00781674	0.00777161	-0.00004513
12. Bytecoin	0.01027010	0.01030080	0.00003069
13. MaidSafeCoin	0.00392011	0.00398622	0.00006612
14. BitShares	0.00448296	0.00442670	-0.00005626
15. MonaCoin	0.00596835	0.00596284	-0.00000552
16. Siacoin	0.00687372	0.00684311	-0.00003061
17. Verge	0.01541028	0.01536572	-0.00004456
18. ReddCoin	0.01164753	0.01159822	-0.00004931

Table 3 shows the comparison results between average excess return and asset pricing analysis. If the comparison result shows a negative value, it means that cryptocurrency *i* is overvalue. If the result shows a positive value, it means that cryptocurrency *i* is undervalue.

As shown on Table III, XRP, Stellar, DASH, NEM, DigiByte, BitShares, MonaCOin, Siacoin, Verge, and ReddCoin are considered overvalue. While Bitcoin, Ethereum, Tether, Litecoin, Monero, Dogecoin, Bytecoin, and MaidSafeCoin are considered undervalue.

Several types of cryptocurrency have maximum supply therefore investors thought that invest on this virtual currency would give them abnormal return. The investors believe that in the future the price of cryptocurrency would be increased significantly (Geuder, Kinateder, and Wagner, 2018). This speculative behavior makes the price of cryptocurrency, especially Bitcoin, become higher from time to time. But the investors should be careful because this high price could be a bubble price and it can explode anytime in the future.

## 5. CONCLUSION

This research proposed three factors model for asset pricing model of cryptocurrency, the three factors model are related to excess market return (rmrf), size (SMB), and network-value-to-transaction ratio (LMH). To evaluate the three factors model performance, we use time series regression. The results show that most of the cryptocurrencies have significant exposures to proposed three factors model and we find that cryptocurrencies that have small market capitalization tend to have higher returns than cryptocurrencies that have big market capitalization.

The results of this research can be used as a benchmark for identifying other additional factors because cryptocurrency market is so complex.

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