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Relative Predictability and Long-Term Institutional Illusory of Cryptocurrencies

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Abstract

Despite the illusory nature of their prospects according to a series of analytic studies, cryptocurrencies remain one of the most popular objects of investment in modern markets. A comparison with a pilot portfolio composed of shares of the comparable promising areas of business will reveal both the temporary competitiveness of cryptocurrencies and the presence of more sound prospects for competitors. The use of Fama – French analysis allows identifying the institutional separation of cryptocurrencies and the unsuitability of traditional tools for their analysis in the long run. At the same time, in the short run, the methods of machine learning and linear regression allow to reveal the relative predictability of cryptocurrencies markets. The Logit model on the base of data from previous periods also reveals additional features that far outweigh random selection.

Keywords: cryptocurrencies, Fama – French, machine learning, portfolio optimization

Introduction

Our research is based on a number of hypotheses that we will try to test:

H_1: investing in robotics, communication technologies, healthcare, and education is no worse investment, than investing in cryptocurrencies, if you take into account profitability and risk,

H_2: the cryptocurrencies market is quite predictable using common modern tools,

H_3: regarding cryptocurrencies market, the Fama - French analysis is not applicable due to the other institutional nature of this asset.

The aim of the study is to examine the competitiveness of cryptocurrencies in the environment of the most successful modern industries and their predictability in the short and long-term.

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For the portfolio analysis will be used next Python packages: pandas_datareader, pandas, numpy, datetime, matplotlib.pyplot. The packages Yfinance (yf), statsmodels (sm) will be necessary for Logit model construction. Linear regression (LR) and machine learning (SVM – Support Vector Machine, DT – Decision Tree) models were chosen for the price prediction.

The most relevant for institutional analysis is the 5 - factors model Fama – French. Unfortunately, as it turned out, this model is not applicable. The portfolio optimization is realized on the base of Sharpe ratio (EfficientFrontier Python package).

The research data will be collected and used from the yahoo.finance on the base of companies' tickers.

Review of the literature

Grym intended to argue that in case of cryptocurrencies we talk about the accounting systems for non-existent asset. He emphasized: 'the fact that miners are unidentified and randomly selected for each transaction does not mean intermediaries are not used' and 'central bank digital currency would practically mean bank accounts at the central bank'. His conclusion is: 'the fundamental nature of digital currencies remains surprisingly elusive' (Grym, 2018).

Bugár and Somogyvári are trying to discover why cryptocurrency 'has not spread as a medium of payment and how it has become a high-risk form of investment instead'. They also tried to explain 'the ideological background for the popularity of bitcoin'. Today, 'bitcoin is primarily a mean for short-term speculation, an investment instrument that has no underlying specific economic process or performance other than its rather high use of energy and resources'. According to them bitcoin in its present form is not suitable 'to become a generally accepted medium of payment' (Bugár, Somogyvári, 2020).

Bordo and Levin addressed this problem from another angle: 'one crucial question is whether central banks should move expeditiously in considering digital currencies adoption'. In particular, it might seem prudent to defer such consideration while monitoring developments in private payments and experiences of 'early adopters' (Bordo, Levin, 2017).

Giudici, Milne and Vinogradov try to disclose 'a few major issues that deserve continued attention'. One is the need for a much closer examination of the market microstructure of cryptoexchanges. Next is 'whether cryptocurrencies have a fundamental own value'. The third concern is 'the societal role of cryptocurrencies and their regulation' (Giudici at al., 2020).

Ahelegbey, Giudici and Mojtahedi found that 'crypto-assets can be clustered in two groups: speculative assets, such as bitcoin, which are mainly 'givers' of tail contagion; and technical assets, such as Ethereum, which are mainly 'receivers' of contagion' (Ahelegbey at al., 2020).

The environment of new instrument adopters today faces the danger of manipulative trust and quasi prospects of new cryptocurrencies. The stock market institution and its rich tools tested over the years should create a base for the conclusions on a sufficiently plausible set of arguments.

Results

Comparison with the pilot project

Firstly we will analyze next portfolio with cryptocurrencies as ingredients: 'DOGE-USD', 'LTC-USD', 'BTC-USD','ETH-USD', 'USDT-USD', 'BNB-USD', 'ADA-USD', 'XRP-USD', 'BCH-USD'.

The ingredients of this portfolio were taken from the yahoo.finance analyzing the first page of ranking and trying to preserve the positive dynamics.

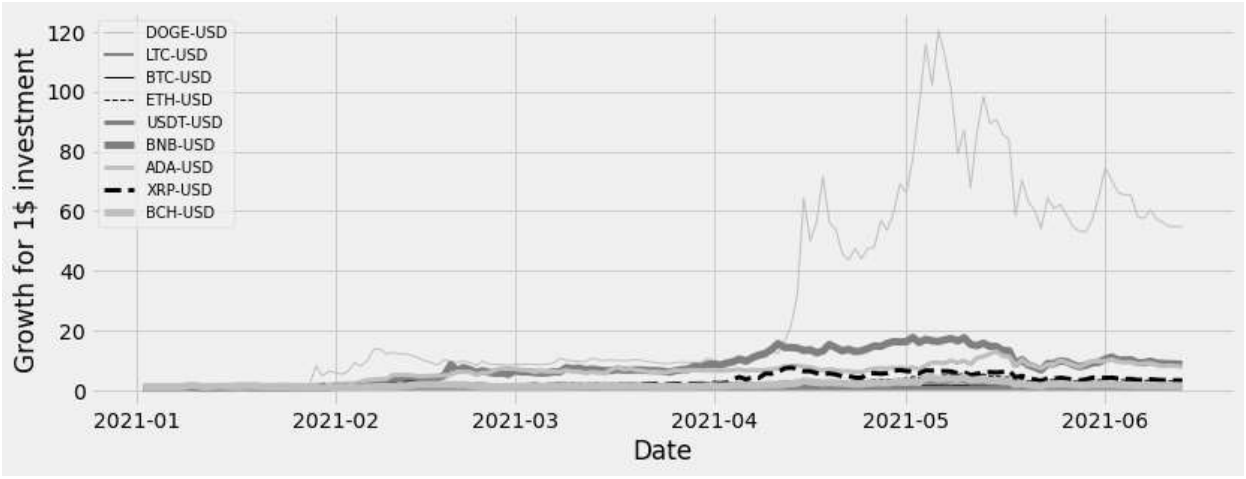


Fig. 1. Cumulative return of the cryptocurrencies portfolio

Source: own elaboration based on: https://finance.yahoo.com/cryptocurrencies [July 1, 2021].

For most cryptocurrencies, the growth of profitability is quite significant, but not as explosive as in the case of DOGE-USD. As we can see from the chart (Fig. 1), the cumulative return on such an investment can rise sharply, surpassing dozens of others and in some moment fall sharply. The object of this research is not to study the behavioural aspects of such veer, but we have great doubts about the long-term perspective of such turns.

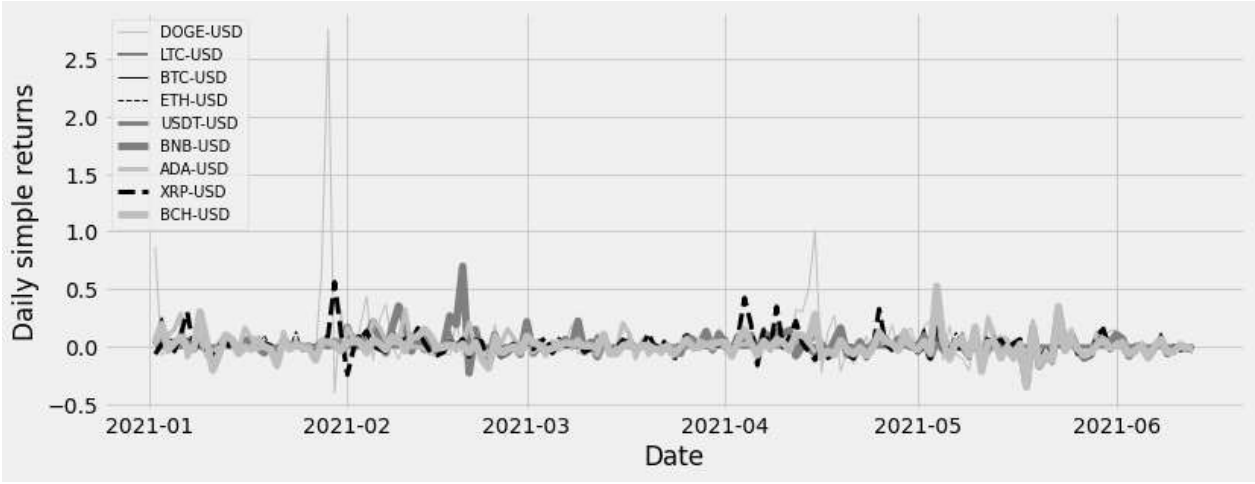


Fig. 2. Volatility of the cryptocurrencies portfolio

Source: own elaboration based on: https://finance.yahoo.com/cryptocurrencies [July 1, 2021].

On the other hand, the level of volatility is extremely high. Sometimes it even reaches the level of 100% (Fig. 2). We are trying to compare the investment attractiveness of the cryptocurrencies market with the most promising modern markets for robotics, education, computer games, healthcare, communications and e-commerce. We will involve one of the leading companies from each sector. The result of the constructed pilot portfolio is given below.

Some details about our pilot portfolio: Chegg (CHGG, CHGG.MX, OCG.F) – one of the best American educational company, Amazon (AMZN) – world leader in e-commerce, Take-Two-Interactive (TTWO, T1TW34.SA, TKE.F) – one of the best internet game producer in the world economy, ADOBE (ADBE) – communication services leader, who only looked back at ZOOM's attempts to compete during the pandemic, Pfizer (PFE) – one of the most perspective health care industry's company in pandemic period, Zebra Technologies (ZBRA) – one of the world leaders in robotics.

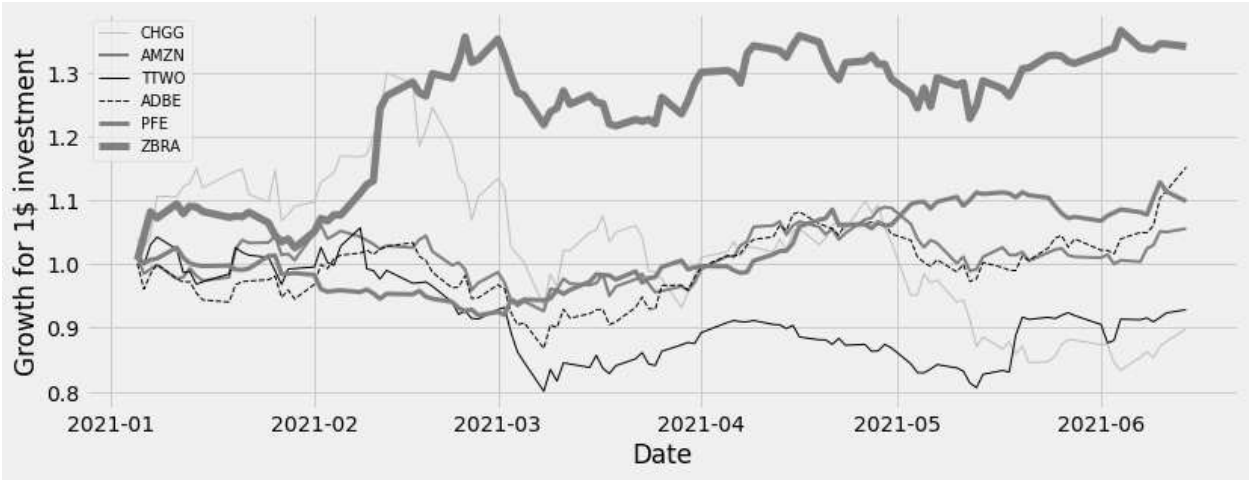


Fig. 3. Cumulative return of the pilot portfolio

Source: own elaboration.

As we can see, our pilot project in some cases compared with cryptocurrencies loses significantly in profitability (Fig. 1, Fig. 3), but at the same time rises in volatility (Fig. 2, Fig.4). We consciously took data only from the last year, realizing that the perception of the market and his individual ingredients under the influence of the pandemic has changed basic stock market heuristics significantly. The desire to win quickly is almost the opposite of a prudent vision of the future. But the growth of the markets of automation, communications, robotics and others is a confirmation of the second part of this thesis.

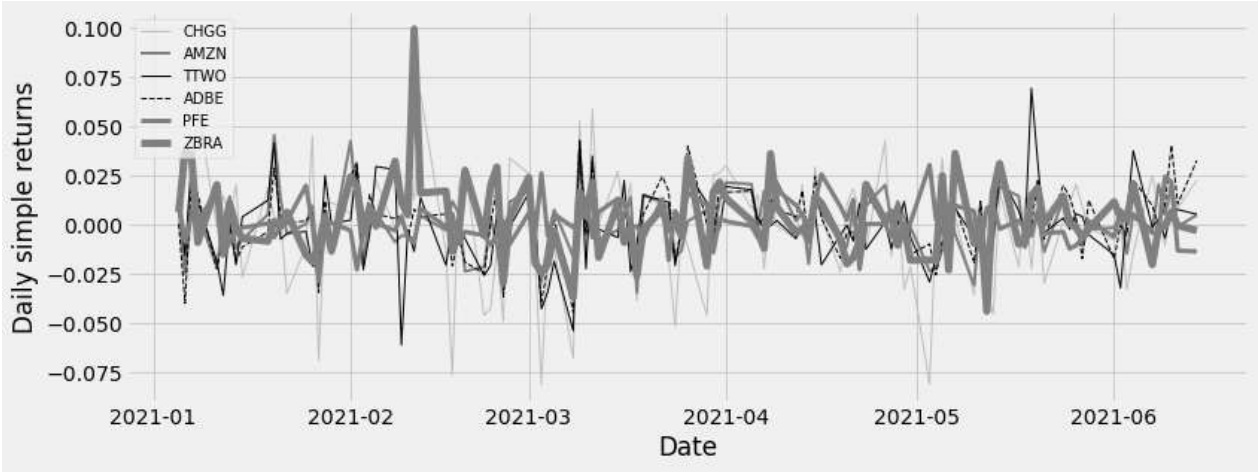


Fig. 4. Volatility of pilot portfolio

Source: own elaboration.

Portfolio Optimization

The optimal portfolio does not focus on investments with either high expected returns or low risk. It aims to balance stocks carrying the best potential returns with acceptable risk. When we plot these, we get the Efficient Frontier. Using EfficientFrontier method we received two important results. First of all, only a small number of cryptocurrencies remain in the optimal portfolio, bypassing such well-known players as bitcoin:

[('DOGE-USD', 0.1904), ('LTC-USD', 0.0), ('BTC-USD', 0.0), ('ETH-USD', 0.0), ('USDT-USD', 0.0), ('BNB-USD', 0.59648), ('ADA-USD', 0.21311), ('XRP-USD', 0.0), ('BCH-USD', 0.0)]

For this optimal portfolio: expected annual return: 220.7%, annual volatility: 86.6%, Sharpe Ratio: 2.53.

If we will reconstruct the portfolio adding alternatives, result will be changed crucially:

[('DOGE-USD', 0.08705), ('LTC-USD', 0.0), ('BTC-USD', 0.0), ('ETH-USD', 0.0), ('USDT-USD', 0.0), ('BNB-USD', 0.25234), ('ADA-USD', 0.09261), ('XRP-USD', 0.0), ('BCH-USD', 0.0), ('CHGG', 0.13338), ('AMZN', 0.19774), ('TTWO', 0.0), ('ADBE', 0.0), ('PFE', 0.0), ('ZBRA', 0.23688)]

Table 1: Extract from the Python code and result of regression

…
data = yf.download("BTC-USD", start = '2019-01-03', end = '2020-01-03')
…
X = df[['const', 'Low1', 'High1', 'High2', 'Close1', 'Close2', 'Close3']]
y = df.Direction
model = sm.Logit(y,X)
…
Model: Logit Pseudo R-squared: 0.148
LLR p-value: 2.0712e-13
Level of predictability is 0.6809116809116809 or 68%.
…

Notes: model based on dayly statistics. Source: own elaboration.

The shares of cryptocurrencies will be significantly reduced, although one of the cryptocurrencies will still remain the leader of the portfolio. There will be a significant decrease in portfolio profitability, but at the same time the lower level of annual volatility.

For this new portfolio: expected annual return: 117.3%, annual volatility: 41.6%, Sharpe Ratio: 2.77. But this portfolio is better because the rate of decrease in volatility exceeds the rate of decrease in profitability.

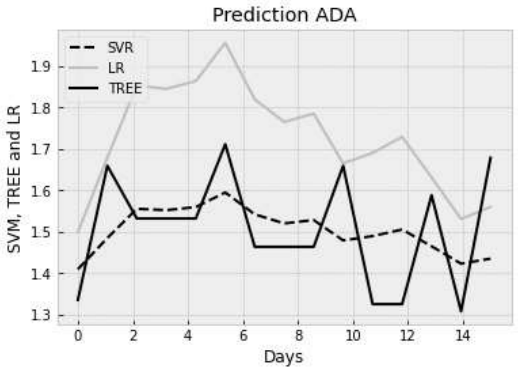
So if we add the companies - leaders in the field of computer games production, e-commerce, robotics, education, communications and healthcare, the primacy of cryptocurrencies does not seem obvious. BNB – USD only maintains a solid position. This means that a potential investor who is not captivated by excessive advertising and thinks rationally will not choose cryptocurrencies.

Based on bitcoin we can check the predictability of cryptocurrencies in terms of data dynamics of previous years. We take every day statistics of the 'high price', the 'low price' and the 'close price' with the corresponding lags 1, 2 or 3 years (Tabl. 1). In this case Pseudo R-squared (as analogy for Adjusted R – squared in Linear Regression) is not satisfied. LLR p-value (analogy for F – criterion) is accepted (Tabl. 1).

The result is indeed better than a random choice (68%), but we do not have enough reason to base our conclusions on such a model. For other cryptocurrencies, the situation is similar.

Short Term Prediction

At the same time, the methods of price prediction in a short period of time is quite effective. Below is a graphical result for four cryptocurrencies (Fig. 5).



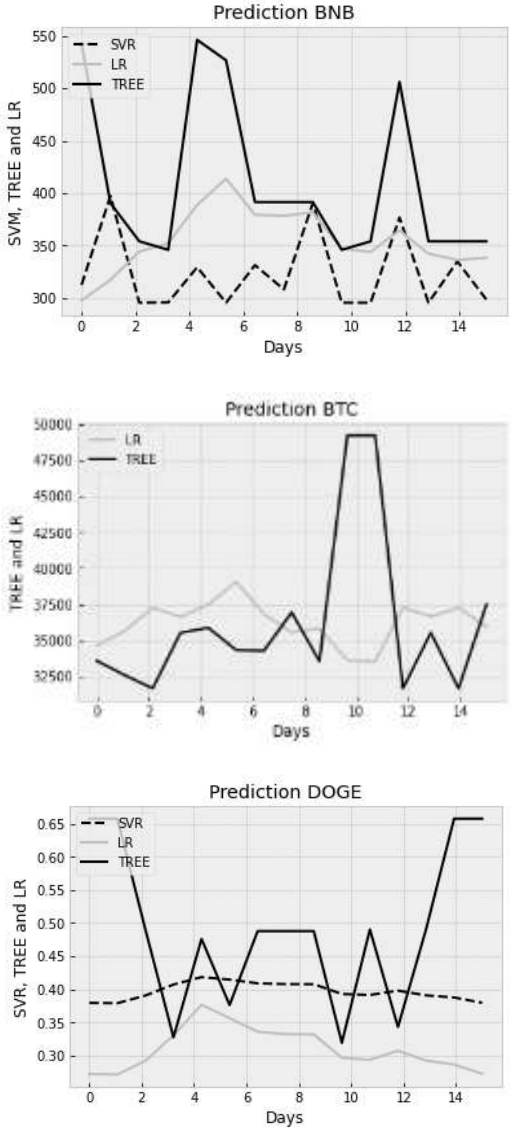


Fig. 5: Prediction on the base of machine learning methods and linear regression

Notes: all three methods are showing relative price stability for the next two weeks. Source: own elaboration.

The confidence level in price prediction methods remains quite satisfactory. In order to test the model the database was divided into two groups in a ratio of 20:80, and then based on 20% of the data the models were tested (Tabl. 2). On the other hand, the application of the Fama – French analysis proved to be not realistic due to the excessively small level of the adjusted coefficient of determination and the insignificant F - criterion. This was shown on the basis of the four most successful cryptocurrencies (Tabl. 3).

Table 2. Confidence level

Cryptocurrencies	SVR	TREE	LIN
DOGE	0.62	0.79	0.72
BTC	-	0.92	0.93
ADA	0.94	0.95	0.92
BNB	0.79	0.87	0.81

Note: the level of coincidence of test and real value is taken into account. Source: own elaboration.

Table 3. 5 - factors Fama – French analysis: main indicators

Cryptocurrencies	Adjusted R^2	Significance of F - criterion	Observations
DOGE-USD	-0.003	0.45	70
BTC-USD	0.07	0.06	70
ADA-USD	-0.05	0.65	34
BNB-USD	-0.09	0.83	36

Notes: for models were taken available monthly data. Source: own elaboration.

In our opinion, the cryptocurrencies market is predictable in the short run and unclear in its long-term perspectives. We drew our conclusions based on individual portfolios of cryptocurrencies that are among world leaders according to the price dynamics. It is clear that the variability of such portfolios may partially call into question such conclusions. Only the most common methods of estimation and prediction are used in this study. On the other hand, it would be interesting to involve econophysical methods in such an analysis.

Conclusions

It is clear that cryptocurrencies are an expression of non-existent assets, which was discussed in our review. But the market did not respond to such warnings and placed cryptocurrencies among the most profitable and at the same time the most volatile investment objects. The study actually confirmed all the proposed hypotheses. The cryptocurrencies market is predictable in the short run and institutionally isolated and distinct in the long run. At the same time, it is quite easy for an attentive investor to show the ability to compete with cryptocurrencies in a range of other markets, including education, robotics, healthcare, industry 4.0, e-commerce and communications. It remains to assume that the aggressiveness of strategies and lack of sufficient information about competitors forces the average investor to choose cryptocurrencies.

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