Momentum or Contrarian.
Which Is the Most Valid in the Case of Cryptocurrencies?

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QFRG Seminar
2018-01-16

Motivation

What?

- Investigate the presence and potential strength of momentum and contrarian effects in the cryptocurrency market

Why?

- Momentum/contrarian effects were identified in the past on young and inefficient markets
- Cryptocurrency market is young, volatile, and rapidly growing
- No one has investigated this yet
- Construct an investment strategy giving abnormal rates of return?

How?

- Construct ranking of TOP100 crypto with the highest market cap
- Construct momentum/contrarian portfolios
- Calculate descriptive statistics
- Benchmark against reference strategies
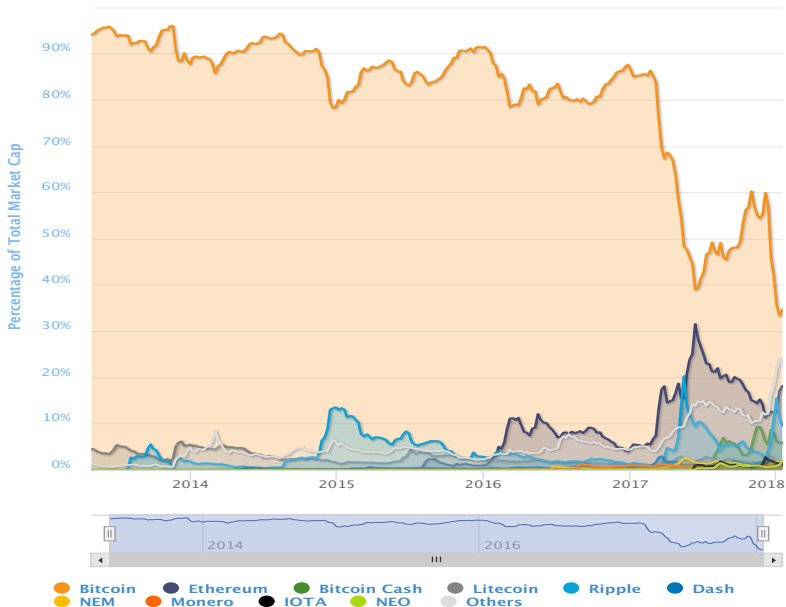- Perform sensitivity analysis of parameters

1. Briefly about cryptocurrency markets
2. Briefly about momentum/contrarian
3. Hypothesis
4. Methodology
5. Data
6. Results
7. Summary
8. Research extensions

Cryptocurrency markets

coinmarketcap.com

Cryptocurrency markets

coinmarketcap.com

Momentum/Contrarian - classical anomalies present on young and ineffective markets.

- Momentum - Tendency for the trends of price changes to continue
- Contrarian - Tendency for the trends of price changes to reverse

Hypothesis

Main Hypothesis:

The momentum and/or contrarian effects are currently present on the cryptocurrency market.

Research Questions:

1. How strong magnitude?
2. Which effect is stronger?
3. Short/medium/long- term?
4. Practical possibility of profit?

During each day:

1. Filter out crypto having 14-day MA volume lower than VF = 100 USD
2. Pick 100 crypto with the largest market cap

We arrive with a $N_{days} \times 100$ matrix that from now on we will call The TOP100.

Note

We now can use TOP100 to construct rankings for any ranking intervals RA $\geq$ 1d.

Methodology - Main Parameters

1. %N - the percent of TOP100 assets that will be used in portfolio construction
2. Reallocation period (RE) - distance between two neighbouring reallocation days
   - Reallocation day - the day we update the composition of our investment portfolio based on some kind of ranking (market cap TOP100 in our case).
3. Ranking window (RA) - time interval used in TOP100
   - In general RA != RE
4. Transaction costs (TC) - as a percentage of total portfolio value
5. Volume filter (VF) - the threshold value for 14-day MA filter

Methodology - Portfolio & Benchmark Construction

We use TOP100 to construct the following portfolios:

1. **Momentum** - equally-weighted investment in %N = 25% of cryptocurrencies with the **highest** weekly rate of return, assume RE = 1w and TC = 0.5%

2. **Contrarian** - equally-weighted investment in %N = 25% of cryptocurrencies with the **lowest** weekly rate of return, assume RE = 1w and TC = 0.5%

And judge their performance in comparison with the benchmark portfolios:

1. **S&P B&H** - buy and hold reference investment using the S&P500 index and the same time horizon

2. **BTC B&H** - buy and hold reference investment using the BTCUSD pair and the same time horizon

3. **EqW** - equally weighted reference investment in all the assets present on TOP100, assume same parameters RE = 1w and TC = 0.5%

4. **McW** - market cap weighted reference investment in all crypto present on TOP100, assume same parameters RE = 1w and TC = 0.5%

Methodology - Portfolio Efficiency

Using on TOP100, calculate the total gross rate of return:

$$R_{0,T}^{(p)} = \prod_{t=1}^{T} \left(1 + \sum_{i=1}^{N} w_{i,t} r_{i,t} - \Delta W_t^R \cdot TC \right) - 1 \,, \tag{1}$$

where:

- N – the total number of assets
- T is the investment's total time horizon (measured in days)
- $w_{i,t}$ is the percentage (weight) of the i-th asset in the whole portfolio p on day t
- $r_{i,t}$ is the simply accruing daily rate of return of the i-th asset on day t
- ΔW_t^R is the total portfolio turnover rate (in percent) on day t
- TC is the total percent transaction costs

Methodology - Descriptive Stats

To benchmark our strategies we also need:

1. annualised rate of change (ARC):

$$\text{ARC} = \left(1 + \frac{P_T}{P_0}\right)^{\frac{365}{T}} - 1, \tag{2}$$

2. annualised standard deviation (ASD):

$$\text{ASD} = \sqrt{\frac{365}{T} \sum_{t=1}^{T} (r_t - \bar{r})^2}, \; r_t = \frac{P_t}{P_{t-1}} - 1 \tag{3}$$

3. maximum drawdown coefficient (MDD):

$$\text{MDD}\,(T) = \max_{\tau \in [0,T]} \left(\max_{t \in [0,\tau]} P_t - P_\tau \right) \tag{4}$$

4. information ratio coefficients (IR1, IR2):

$$
\begin{aligned}
\text{IR1} &= \text{ARC}/\text{ASD} \\
\text{IR2} &= \text{sign}(\text{ARC})\text{ARC}^2/(\text{ASD} \cdot \text{MDD})
\end{aligned} \tag{5}
$$

Data

1. Daily OHLC prices, market cap and 24h-volume data
2. In-sample time horizon: 2014-05-12 to 2017-10-28 for 1200+ cryptocurrencies
3. BTCUSD and S&P500 daily close prices as benchmarks
4. Data source: www.coinmarketcap.com

Data histograms

Market Cap

Mean=61,079,918
Min=0
Max=100,438,000,000
Total Incomplete=11.6%
Total Variables=1223

Number of Observations

Data Incompleteness [%]

Volume (24h)

Mean=1,446,369
Min=0
Max=4,148,070,000
Total Incomplete=9.05%
Total Variables=1223

Number of Observations

Data incompleteness [%]

Data filtering
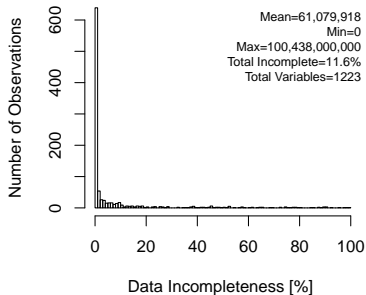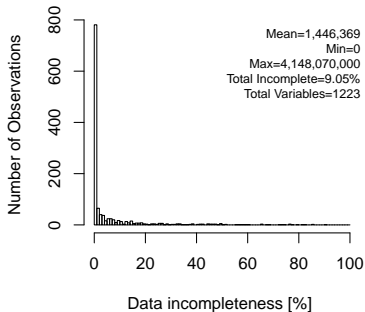
Missing values handling:

1. Close: Fill missing observations with last non-missing entry
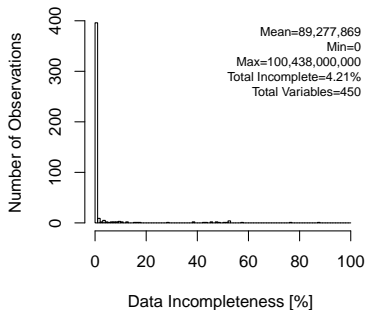2. MarketCap: Calculate missing from the circulating supply approximate formula: $MC_t = (1 + r_t) MC_{t-1}$.
3. Volume: Filter out all observations for which 14-day rolling mean volume $< VF = 100$ USD

After that $\longrightarrow$ construct TOP100.

Market Cap

Number of Observations

Mean=89,277,869
Min=0
Max=100,438,000,000
Total Incomplete=4.21%
Total Variables=450

Data Incompleteness [%]

Volume (24h)

Number of Observations

Mean=2,268,025
Min=0
Max=4,148,070,000
Total Incomplete=0%
Total Variables=450

Data Incompleteness [%]
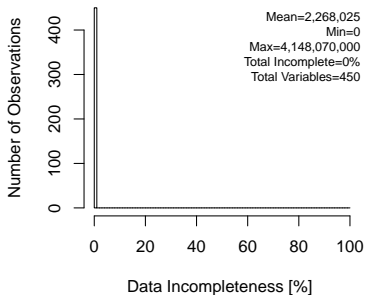
Sample crypto data - 2017-10-28

First 10 cryptocurrencies in TOP100 AOD 2017-10-28								
Nazwa	%ARC	%ASD	%MDD	IR1	IR2	Start Date	MarketCap [USD]	Volume (24h) [USD]	%MD
bitcoin	109.8	66.4	73.3	1.7	2.5	2014-05-12	96,369,600,000	1,403,920,000	0
ethereum	714.8	154.9	84.3	4.6	39.1	2015-08-08	28,410,400,000	264,424,000	0
ripple	176.6	155.0	85.4	1.1	2.4	2014-05-12	7,806,200,000	26,864,900	0
bitcoin-cash	9.7	245.9	58.5	0.0	0.0	2017-08-02	6,183,520,000	781,037,000	0
litecoin	61.4	110.5	90.0	0.6	0.4	2014-05-12	2,966,700,000	71,063,200	0
dash	289.8	147.2	92.9	2.0	6.1	2014-05-12	2,152,090,000	47,092,100	0
nem	1,246.5	180.1	75.0	6.9	115.1	2015-04-01	1,781,830,000	4,671,300	0
bitconnect	Inf	206.5	51.6	6,212.7	Inf	2017-01-20	1,558,580,000	10,550,800	0
neo	2,989.8	270.8	85.6	11.0	385.4	2016-10-26	1,443,000,000	25,368,200	0
monero	218.6	155.4	95.5	1.4	3.2	2014-05-21	1,327,650,000	25,397,400	0

Last 10 cryptocurrencies in TOP100 AOD 2017-10-28								
Nazwa	%ARC	%ASD	%MDD	IR1	IR2	Start Date	MarketCap [USD]	Volume (24h) [USD]	%MD
zencash	288.7	386.5	82.7	0.7	2.6	2017-06-07	49,749,900	1,464,900	0
edgeless	18,466.6	377.6	70.8	48.9	12,752.3	2017-04-07	49,017,500	961,797	0
aragon	-11.4	188.6	65.6	-0.1	0.0	2017-05-20	48,817,400	376,313	0
rlc	339.1	213.9	77.0	1.6	7.0	2017-04-22	48,397,600	231,263	0
taas	2,726.2	149.6	59.0	18.2	842.2	2017-05-12	46,407,500	230,103	0
nolimitcoin	8,500.0	635.2	92.0	13.4	1,236.6	2016-09-12	45,917,600	84,228	0
nav-coin	396.0	472.9	94.9	0.8	3.5	2014-06-12	45,209,300	502,409	0
loopring	718.2	343.1	73.2	2.1	20.5	2017-09-03	42,275,700	188,744	0
wings	4,405.1	291.0	73.1	15.1	911.7	2017-04-28	41,613,800	434,531	0
kin	-100.0	180.3	56.9	-0.6	1.0	2017-09-03	39,996,200	38,250	0

Legend:

- Inf - more than 100,000
- Start Date - the first day the asset has appeared on TOP100
- %MD - percentage of missing data

Results I

Name	%N	RE	RA	%TC	VF	%ARC	%ASD	%MDD	IR1	IR2	%MT
S&P B&H	-	-	-	-	-	9.3	12.3	14.2	0.8	0.5	0.0
BTC B&H	-	-	-	-	-	109.6	66.3	73.3	1.7	2.5	0.0
McW	100	1w	-	0.5	100	120.0	64.7	71.0	1.9	3.1	0.5
EqW	100	1w	-	0.5	100	**264.0**	88.9	70.6	**3.0**	**11.1**	3.8
Momentum	25	1w	1w	0.5	100	80.6	110.7	84.8	0.7	0.7	21.8
Contrarian	25	1w	1w	0.5	100	474.4	127.5	58.0	3.7	30.5	23.3

Legend: McW - MarketCap weighted strategy, EqW - Equally Weighted strategy, %N - percent of TOP100 currencies used to construct the portfolio, RE - reallocation period, RA - width of the ranking window used to calculate the highest/lowest rates of return, %TC - total transaction costs, VF - volume filter threshold, %ARC - annualised rate of return, %ASD - annualised standard deviation, %MDD - maximum drawdown, IR1, IR2 - risk-weighted gain coefficients, %MT - portfolio mean turnover ratio.

1. EqW portfolio is the most efficient among other benchmarks
2. Strong outperformance of contrarian strategy over reference portfolios
3. Momentum portfolio performs better than reference portfolios from regulated markets being worse than crypto benchmarks
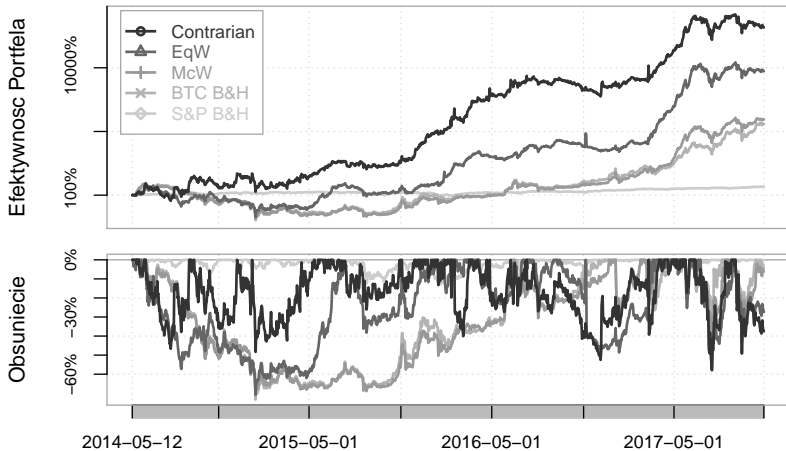
Momentum, %N=25, RE=1w, RA=1w, KT=0.5%, VF=100
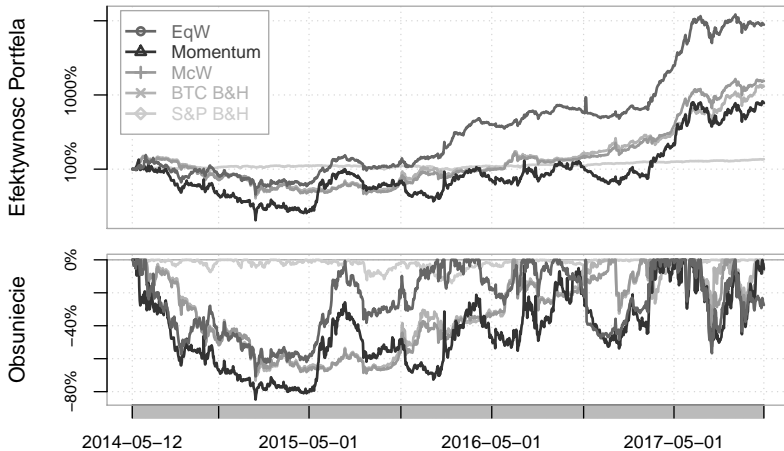
Contrarian, %N=25, RE=1w, RA=1w, KT=0.5%, VF=100

1. %N = 5%, 10%, **25%**, 50%
2. Reallocation period RE = 1d, **1w**, 1m
3. Ranking window RA = 1d, **1w**, 1m
4. Transaction costs TC - 0.25%, **0.5%**, 1%
5. Volume filter VF = **100**

Sensitivity Analysis I

					Benchmark Strategies										
	Nazwa				%ARC	%ASD	%MDD	IR1	IR2	%MT	%ARC	%ASD	%MDD	IR1	IR2	%MT
	S&P B&H				9.3	12.3	14.2	0.8	0.5	0.0	9.3	12.3	14.2	0.8	0.5	0.0
	BTC B&H				109.6	66.3	73.3	1.7	2.5	0.0	109.6	66.3	73.3	1.7	2.5	0.0
	McW				120.0	64.7	71.0	1.9	3.1	0.5	120.0	64.7	71.0	1.9	3.1	0.5
	EqW				264.0	88.9	70.6	3.0	11.1	3.8	264.0	88.9	70.6	3.0	11.1	3.8

Parameters					MOMENTUM						CONTRARIAN					
%N	RE	RA	%KT	VF	%ARC	%ASD	%MDD	IR1	IR2	%MT	%ARC	%ASD	%MDD	IR1	IR2	%MT
25	1d	1w	0.50	100	-87.3	125.7	100.0	-0.7	0.6	69.6	83,818.2	107.5	48.6	779.6	Inf	81.6
25	**1w**	**1w**	**0.50**	**100**	80.6	110.7	84.8	0.7	0.7	21.8	474.4	127.5	58.0	3.7	30.5	23.3
25	1m	1w	0.50	100	229.8	117.1	77.6	2.0	5.8	5.3	124.5	138.8	76.3	0.9	1.5	5.4
25	1w	1d	0.50	100	30.2	107.5	83.6	0.3	0.1	21.4	695.1	173.0	75.4	4.0	37.0	21.9
25	**1w**	**1w**	**0.50**	**100**	80.6	110.7	84.8	0.7	0.7	21.8	474.4	127.5	58.0	3.7	30.5	23.3
25	1w	1m	0.50	100	236.6	114.9	62.5	2.1	7.8	11.9	294.4	111.2	85.5	2.6	9.1	13.3
5	1w	1w	0.50	100	-48.7	250.1	99.8	-0.2	0.1	25.9	6,717.3	321.6	71.8	20.9	1,955.4	27.2
10	1w	1w	0.50	100	38.2	168.4	95.3	0.2	0.1	24.3	2,446.7	210.4	61.8	11.6	460.3	26.4
25	**1w**	**1w**	**0.50**	**100**	80.6	110.7	84.8	0.7	0.7	21.8	474.4	127.5	58.0	3.7	30.5	23.3
50	1w	1w	0.50	100	137.8	89.4	81.1	1.5	2.6	15.8	308.8	112.3	61.4	2.7	13.8	16.9
25	1w	1w	0.25	100	120.4	110.6	82.6	1.1	1.6	21.8	611.7	127.4	57.2	4.8	51.4	23.3
25	**1w**	**1w**	**0.50**	**100**	80.6	110.7	84.8	0.7	0.7	21.8	474.4	127.5	58.0	3.7	30.5	23.3
25	1w	1w	1.00	100	20.9	111.1	88.4	0.2	0.0	21.8	273.2	128.0	60.3	2.1	9.7	23.3
10	1d	1d	0.50	100	-100.0	230.6	100.0	-0.4	0.4	172.0	Inf	220.4	61.1	Inf	Inf	182.0
25	**1w**	**1w**	**0.50**	**100**	80.6	110.7	84.8	0.7	0.7	21.8	474.4	127.5	58.0	3.7	30.5	23.3
50	1m	1m	0.50	100	265.4	94.1	61.2	2.8	12.2	3.9	171.9	115.2	81.1	1.5	3.2	4.2

Sensitivity Analysis II

1. The sensitivity analysis confirms the initial results
2. The results for various parameters reveal substantial volatility
3. Strong monotonic effect in case of the efficiency of contrarian and momentum strategies:
   - Contrarian portfolio increase their efficiency when:
     - RE decreases
     - RA decreases
     - %N decreases
   - Momentum portfolio increase their efficiency when:
     - RE increases
     - RA increases
     - %N increases

Portfolio Diversification

1. Investigation of the correlation matrix gives us a tip that any investigated cryptocurrency portfolio has a huge diversification potential when combined with regular investment portfolios represented by S&P500 B&H strategy.

	S&P B&H	BTC B&H	McW	EqW	Momentum	Contrarian
S&P B&H	**1.0000**	**-0.0169**	**-0.0126**	**-0.0105**	**-0.0428**	**0.0128**
BTC B&H	-0.0169	1.0000	0.9474	0.6091	0.4944	0.4280
McW	-0.0127	0.9474	1.0000	0.6785	0.5450	0.4789
EqW	-0.0105	0.6091	0.6785	1.0000	0.6685	0.5983
Momentum	-0.0428	0.4944	0.5450	0.6685	1.0000	0.3288
Contrarian	0.0128	0.4280	0.4789	0.5983	0.3288	1.0000

Summary

1. Strong contrarian and momentum effect on cryptocurrency market
2. Contrarian is much stronger than Momentum and reference strategies
3. Sensitivity analysis performed for various parameters confirms our initial results
4. Strong monotonic effect in case of efficiency of contrarain and momentum strategies

Research extensions

1. Reproduce results on 1-minute data
2. Repeat calculations for quotes against BTC instead of USD
3. Check the results for larger set of parameters and more conservative transaction costs
4. Show the results on out-of-sample data starting from 2017-10-28
5. Prepare an on-line interactive version of this research with weekly update of each strategy

Thank you!

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