

On-chain analytics for sentiment-driven statistical causality in cryptocurrencies

Supplementary material

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Version: November 24, 2021

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1. Entropy-based sentiment indices

This section includes the plots of the sentiment indices (Figures 1 - 9) for all assets (BTC, ETH, LTC, TRX, XRP) and all sources (Cryptodaily, Cryptoslate) that are not included in the main paper. We show a 10-day rolling (overlapping window by 1 day) mean and median of the daily sentiment, together with the 95% smoothed confidence intervals. To construct the intervals we compute the time-series of the 95-th and 5-th percentile and smooth them with the same 10-day window. The sentiment indices were constructed using a custom-built dictionary for the cryptospace after consultation with experts. Table 1 presents the sources of our dictionary, and Algorithm 1 presents the procedure to extract sentiment from the text time-series. Finally, an example of applying the text embedding framework is shown in Table 2. The text is an excerpt of an article on Bitcoin from Cryptoslate¹.

Table 1. Details of the sources we used to built our dictionary.

Dictionary	Size	Source
Cryptowords	410	https://medium.com/@IWILLTEACHCRYPTO/300-common-cryptocurrency-layman-words-terms-you-dont-know-crypto-dictionary-7d87f670d487 https://medium.com/coinmonks/cryptocurrency-lingo-cheat-sheet-crypto-terms-you-need-to-know-42abc0db6fc6 https://cryptominded.com/glossary-cryptocurrency-terms-need-know/ https://www.fxcm.com/uk/insights/the-most-popular-cryptocurrency-terms-and-phrases/ https://www.cnbc.com/2018/01/23/what-hodl-whale-and-other-cryptocurrency-slang-terms-mean.html https://www.finder.com/cryptocurrency-glossary https://changelly.com/blog/cryptocurrency-terms-and-slang/ https://www.collinsdictionary.com/web-lists/economics-branches-of-economics
Business, Economics and Finance	86,545	When is a Liability not a Liability? Textual Analysis, Dictionaries, and 10-Ks Loughran and McDonald (2011) https://www.oxfordreference.com/view/10.1093/acref/9780198725725.001.0001/acref-9780198725725
Engineering and technology	10,159	https://www.engineering-dictionary.com/index.php?letter=A https://myvocabulary.com/word-list/engineeringvocabulary https://www.collinsdictionary.com/web-lists/engineering-branches-of-engineering https://www.oxfordreference.com/view/10.1093/acref/9780191826740.001.0001/acref-9780191826740 https://www.oxfordreference.com/view/10.1093/acref/9780191803093.001.0001/acref-9780191803093 https://www.oxfordreference.com/view/10.1093/acref/9780191863592.001.0001/acref-9780191863592 https://www.oxfordreference.com/view/10.1093/acref/9780191800986.001.0001/acref-9780191800986 https://www.oxfordreference.com/view/10.1093/acref/9780199646241.001.0001/acref-9780199646241 https://www.oxfordreference.com/view/10.1093/acref/9780199587261.001.0001/acref-9780199587261 https://www.ket.org/education/resources/drama-glossary/#word-wall-printouts https://myvocabulary.com/word-list/media-literacy-vocabulary https://www.oxfordreference.com/view/10.1093/acref/9780199688975.001.0001/acref-9780199688975 http://www.math.utah.edu/~wisia/glossary.html
Media	7,360	https://www.englishclub.com/vocabulary/computer.php https://www.enchantedlearning.com/wordlist/computer.shtml https://www.ourcommunity.com.au/tech/tech_article.jsp?articleId=74 https://www.collinsdictionary.com/web-lists/computer-terms-used-in-computing https://www.oxfordreference.com/view/10.1093/acref/9780199679591.001.0001/acref-9780199679591
Computing	6,822	https://www.storyofmathematics.com/glossary.html https://myvocabulary.com/word-list/math-vocabulary/ https://www.collinsdictionary.com/web-lists/mathematics-mathematical-terms Academic wordlist: https://www.wgtn.ac.nz/lals/resources/academicwordlist
Mathematics	3,476	Oxford 5000 word list: https://www.oxfordlearnersdictionaries.com/wordlists/oxford3000-5000 Oxford World-Place names: https://www.oxfordreference.com/view/10.1093/acref/9780199580897.001.0001/acref-9780199580897
Baseline dictionary	245,318	https://www.rollingstone.com/music/music-lists/100-greatest-artists-147446/ https://www.biographyonline.net/people/100-most-influential.html https://time.com/collection/most-influential-people-2018/ https://time.com/collection/100-most-influential-people-2019/ Unix built-in default dictionary

¹ Bill DeLisle, <https://cryptoslate.com/bitcoin-rises-peter-thiel-announces-big-investment/>

Input : n -gram t_N , n -gram counts C^{t_N} , word lists V_{pos}
 V_{neg} , $V_{neutral}$

Output : $C_{pos}^{t_N}, C_{neg}^{t_N}, C_{neutral}^{t_N}$ count matrices for each sentiment for t_N

Initialisation: $cnt_{pos} \leftarrow 0$, $cnt_{neg} \leftarrow 0$

for $w \leftarrow 1$ **to** n **do**

- | **if** $t_{wN} \in V_{pos}$ **then**
- | | $cnt_{pos} = cnt_{pos} + 1$
- | **if** $t_{wN} \in V_{neg}$ **then**
- | | $cnt_{neg} = cnt_{neg} + 1$
- | **if** $t_{wN} \in V_{neutral}$ **then**
- | | $cnt_{pos} = cnt_{pos} + 1$;
- | | $cnt_{neg} = cnt_{neg} + 1$

end

$polarity \leftarrow cnt_{pos} - cnt_{neg}$;

for $w \leftarrow 1$ **to** n **do**

- | $c_w \leftarrow C^{t_N}[w] + polarity$;
- | **if** $polarity = 0$ **or** $c_w = 0$ **then**
- | | $C_{neutral}^{t_N}[w] \leftarrow C^{t_N}[w]$
- | **else if** $c_w > 0$ **then**
- | | $C_{pos}^{t_N}[w] \leftarrow c_w$
- | **else**
- | | $C_{neg}^{t_N}[w] \leftarrow |c_w|$

end

end

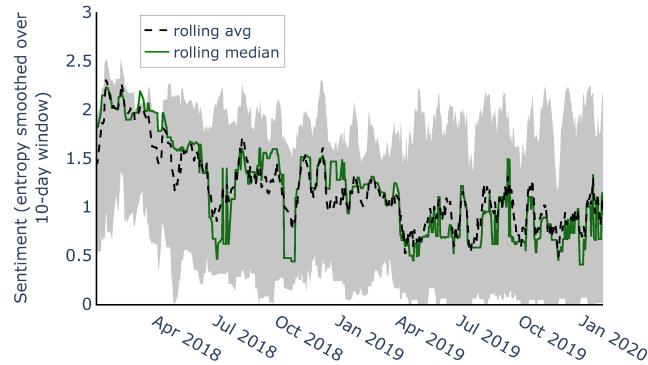
Algorithm 1: Generate sentiment count matrices.**Table 2****(a)****Bitcoin Rises After Peter Thiel Announces Big Investment**

Bitcoin is starting 2018 in familiar fashion: with big gains.’ ‘This time, the gains seem to be inspired by the news, first reported by The Wall Street Journal, that early Facebook investor, Peter Thiel, invested millions of dollars in the digital currency.’ ‘Thiel is the co-founder of Founders Fund, a venture capital firm that makes investments in tech startups. It’s most famous for its early stake in Facebook. Today we learned that Founders Fund purchased ‘\$15 million to \$20 million’ Bitcoin, according to the Journal’s report.’ ‘The support has sparked Bitcoin’s ascension today. With relatively tepid growth since the middle of December, Bitcoin surpassed \$15,000 for the first time since December 27th and just the second time since December 20th, based on current charts.’ ‘Although Bitcoin and other cryptocurrencies are prone to dips in value, December’s short lag began with a market downturn just before Christmas and, spurred on by fears of South Korean government regulation, continued through the New Year’s holiday.’

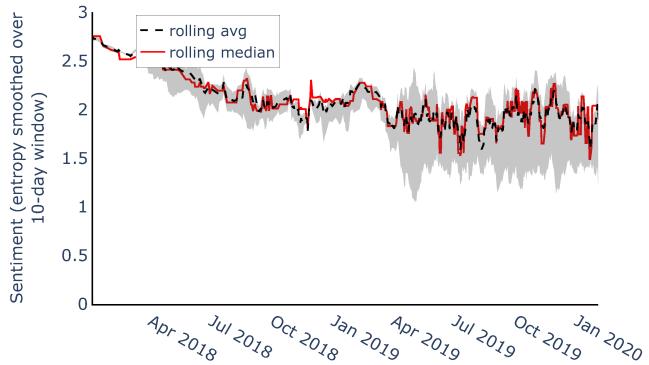
(b) Text embedding and sentiment index for text segment in (a).

Time step	Ngram	Entropy (all tokens)	Entropy Support of positive tokens	Entropy Support of negative tokens	Entropy Support of neutral tokens
0	bitcoin; starting; familiar; fashion; big; gains; time; gains; inspired; news; reported; wall street journal; early; facebook; investor; peter; invested; millions; dollars; digital currency	2.926	2.942	-	-
1	co; founder; founders; fund; venture; capital; firm; makes; investments; tech; startups; famous; early; stake; facebook; today; learned; founders; fund; purchased	2.839	-	-	2.857
2	million; million; bitcoin; according to; journal; report; support; sparked; bitcoin; ascension; today; relatively; tepid; growth; middle; december; bitcoin; surpassed; time; december	2.653	2.669	-	-
3	second; time; december; based; current; charts; bitcoin; cryptocurrencies; prone; dips; value; december; short; lag; began; market; downturn; christmas; spurred; fears	2.729	-	2.943	-

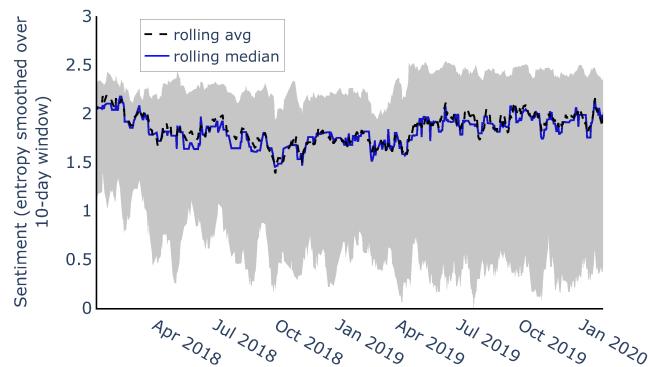
1 ENTROPY-BASED SENTIMENT INDICES



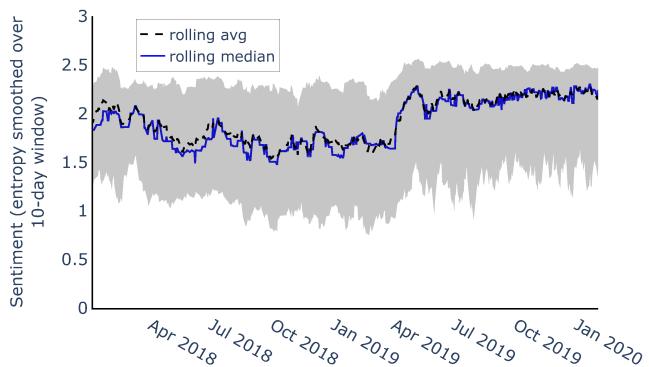
(a) Positive sentiment



(b) Negative sentiment



(c) Neutral sentiment



(d) Absolute sentiment strength

Figure 1. Cryptodaily ETH - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

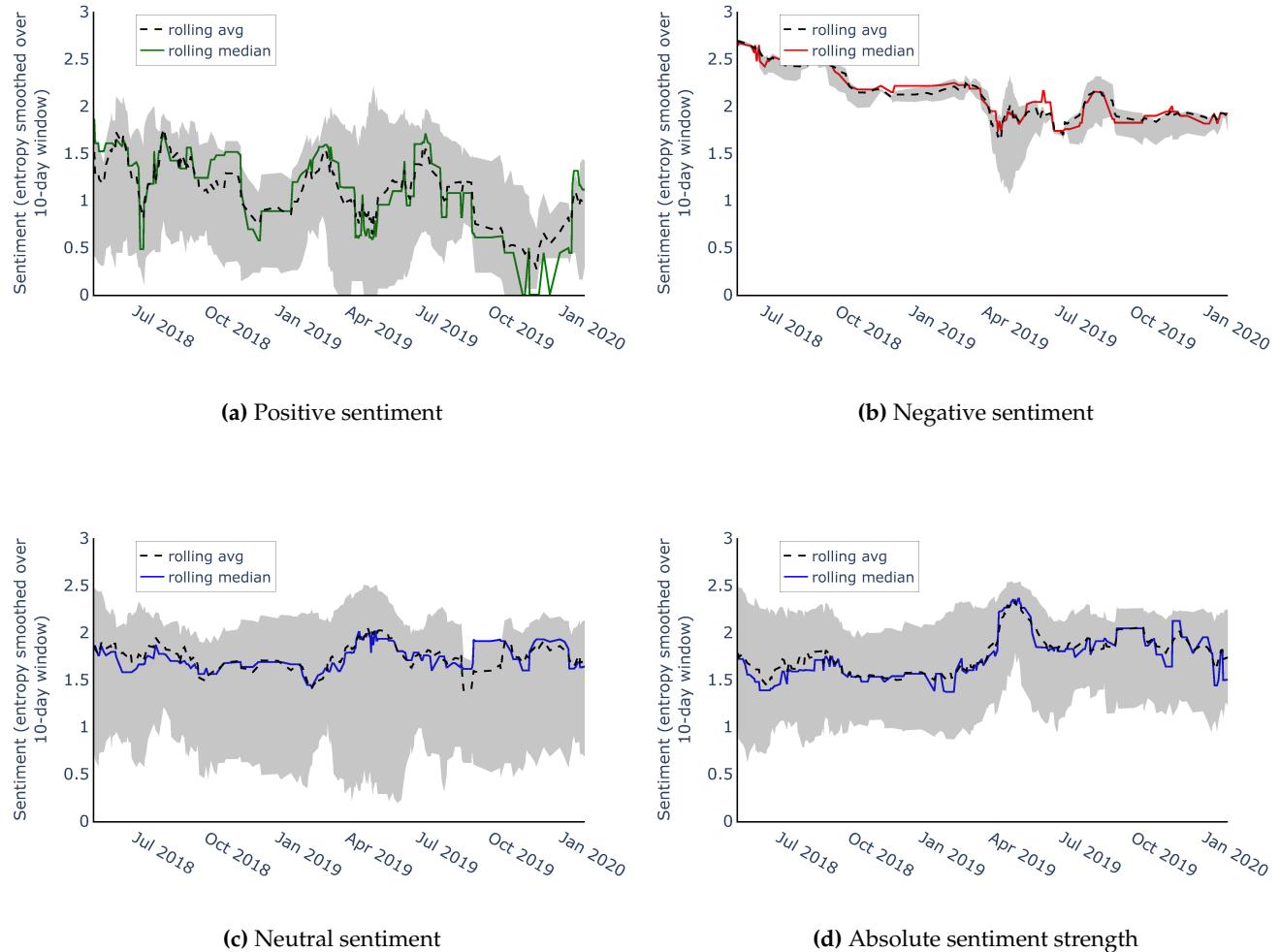


Figure 2. Cryptodaily LTC - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

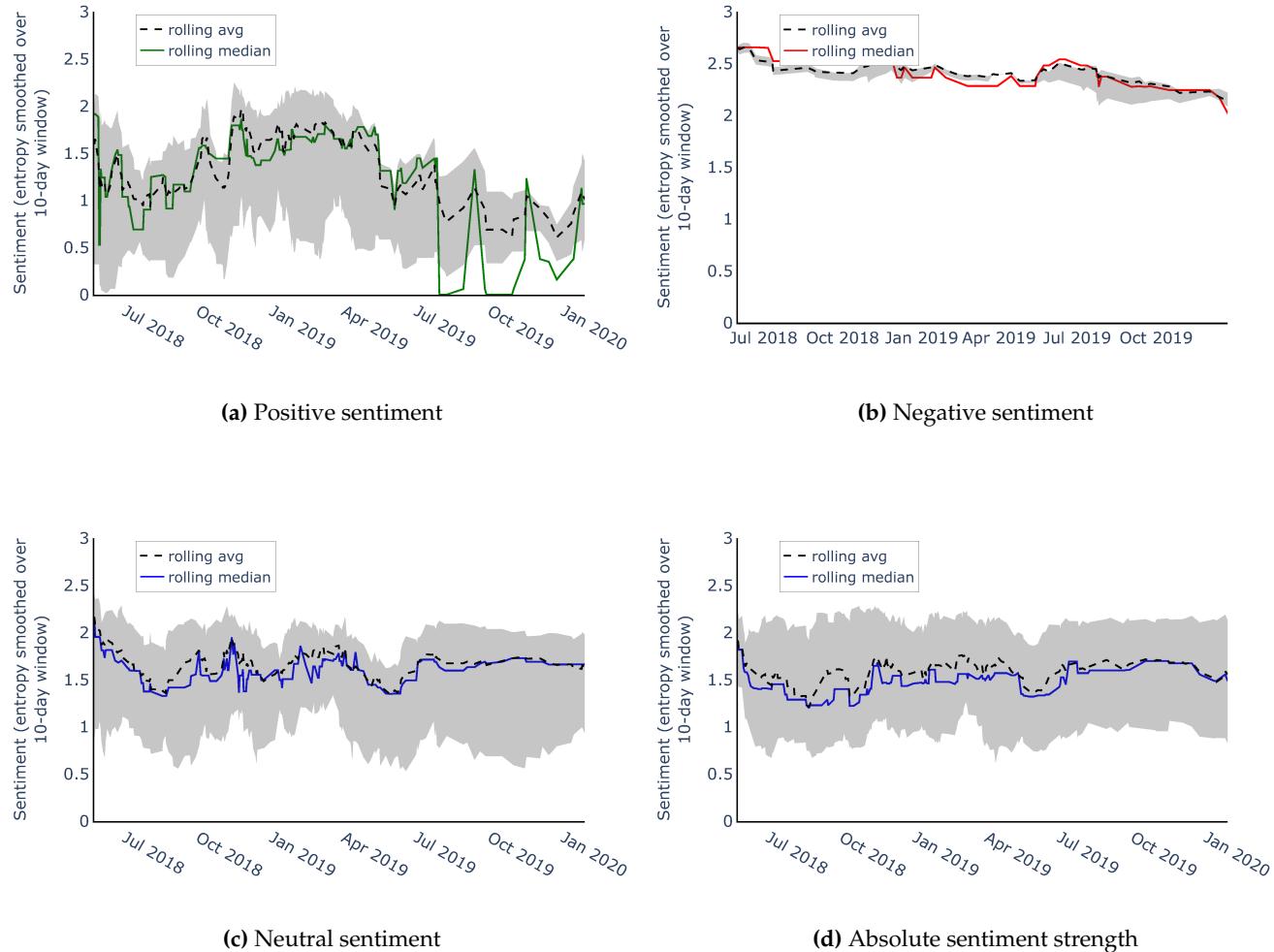


Figure 3. Cryptodaily TRX - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

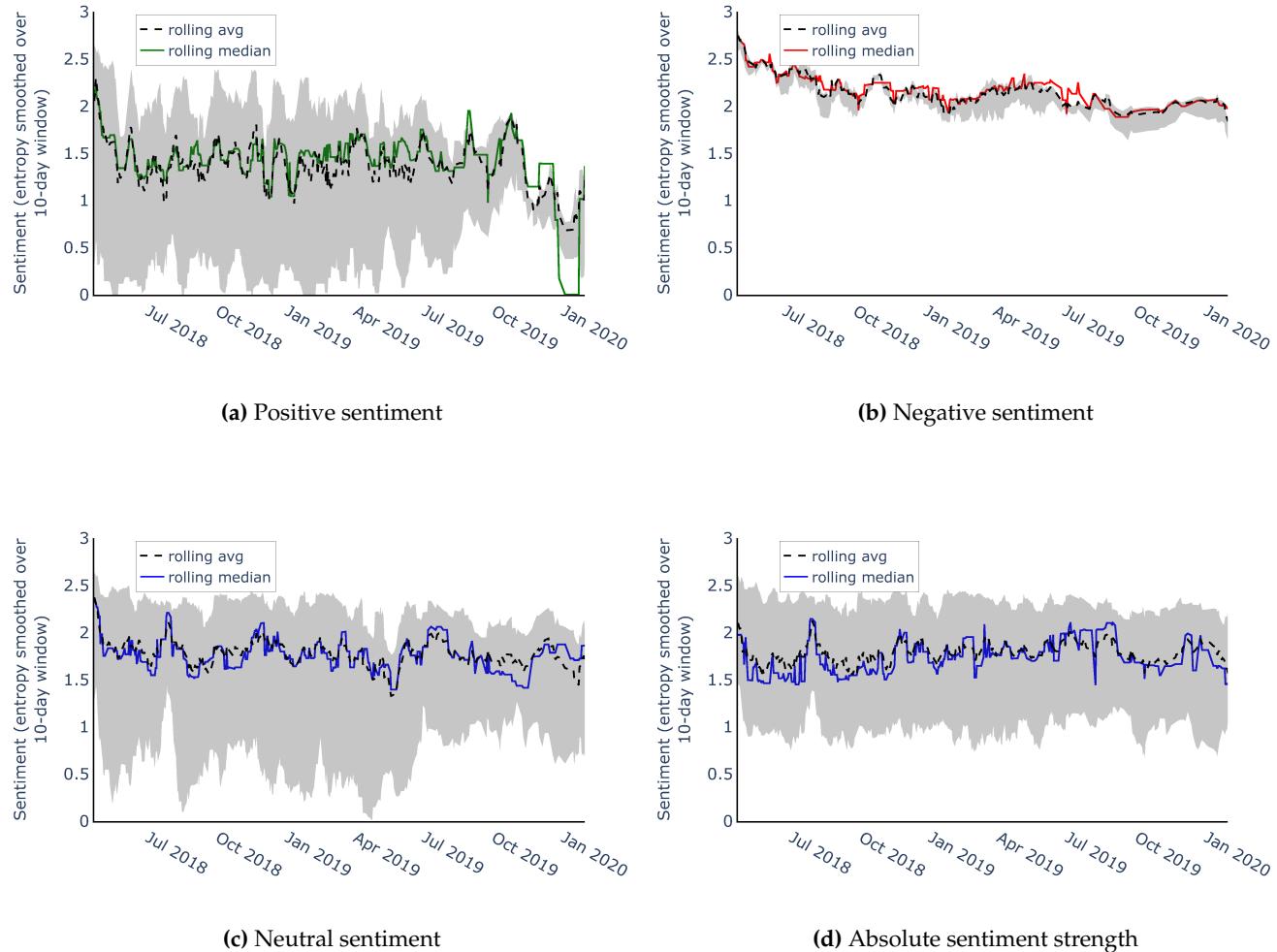


Figure 4. Cryptodaily XRP - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

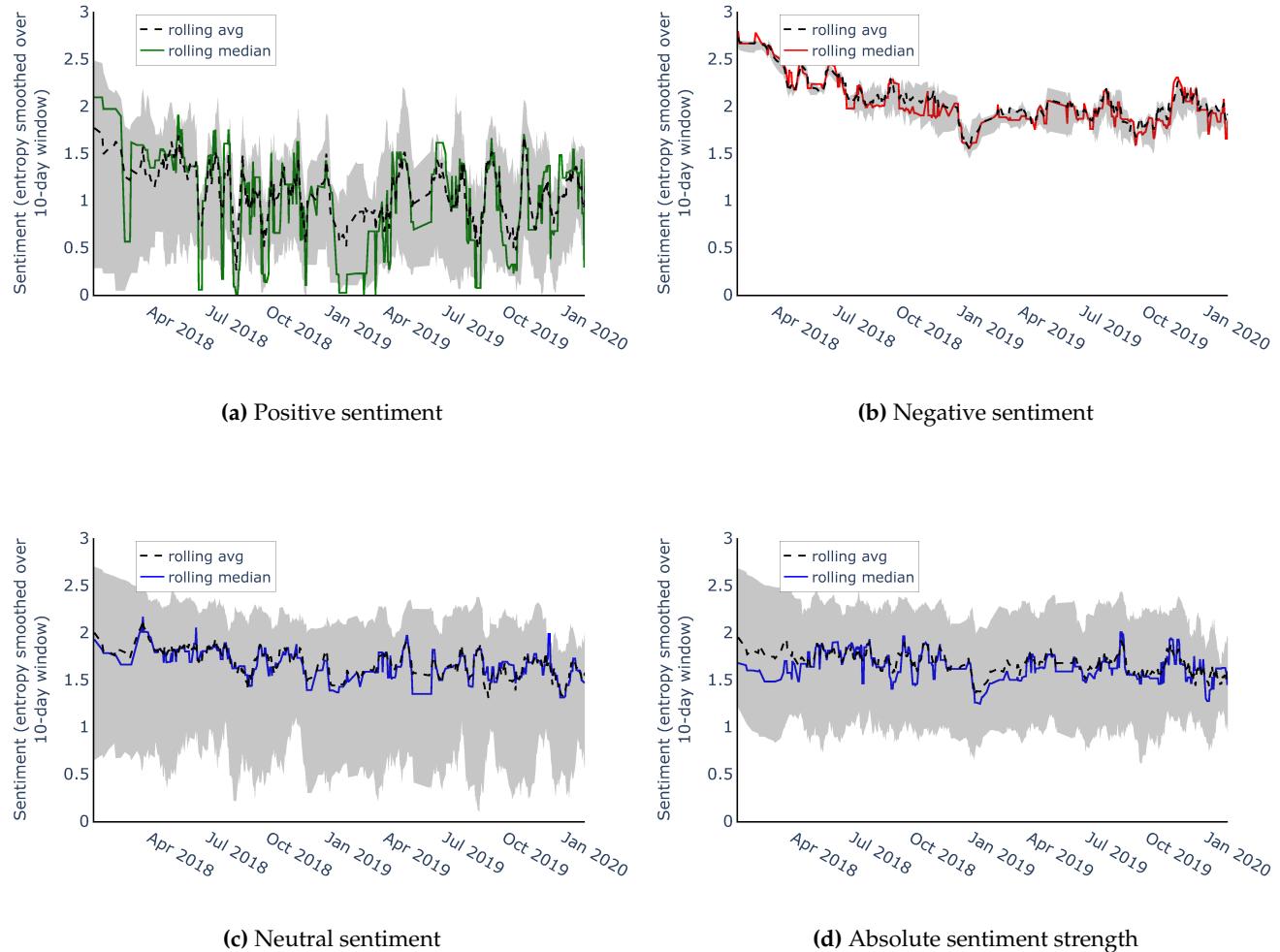


Figure 5. Cryptoslate BTC - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

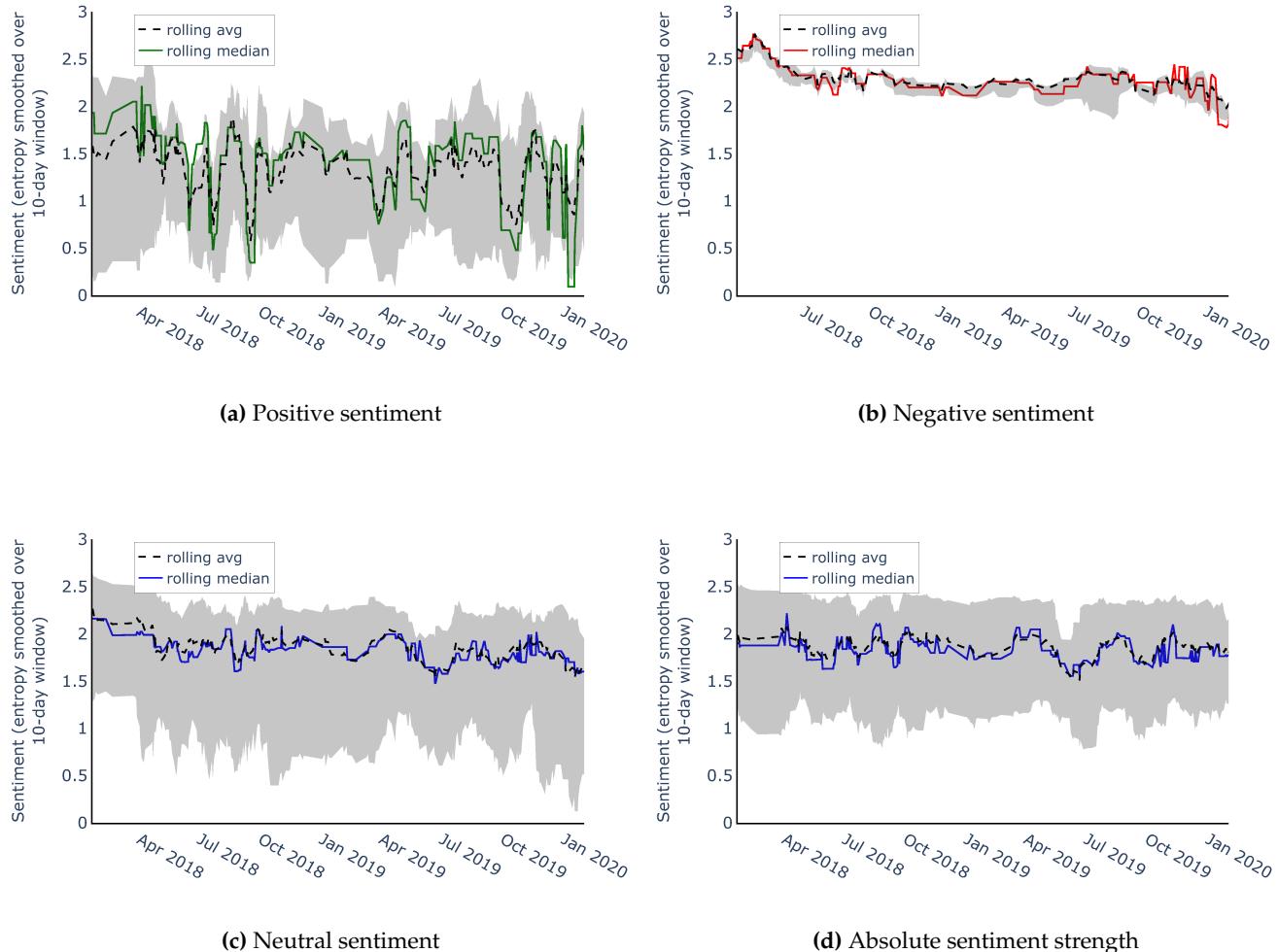


Figure 6. Cryptoslate ETH - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

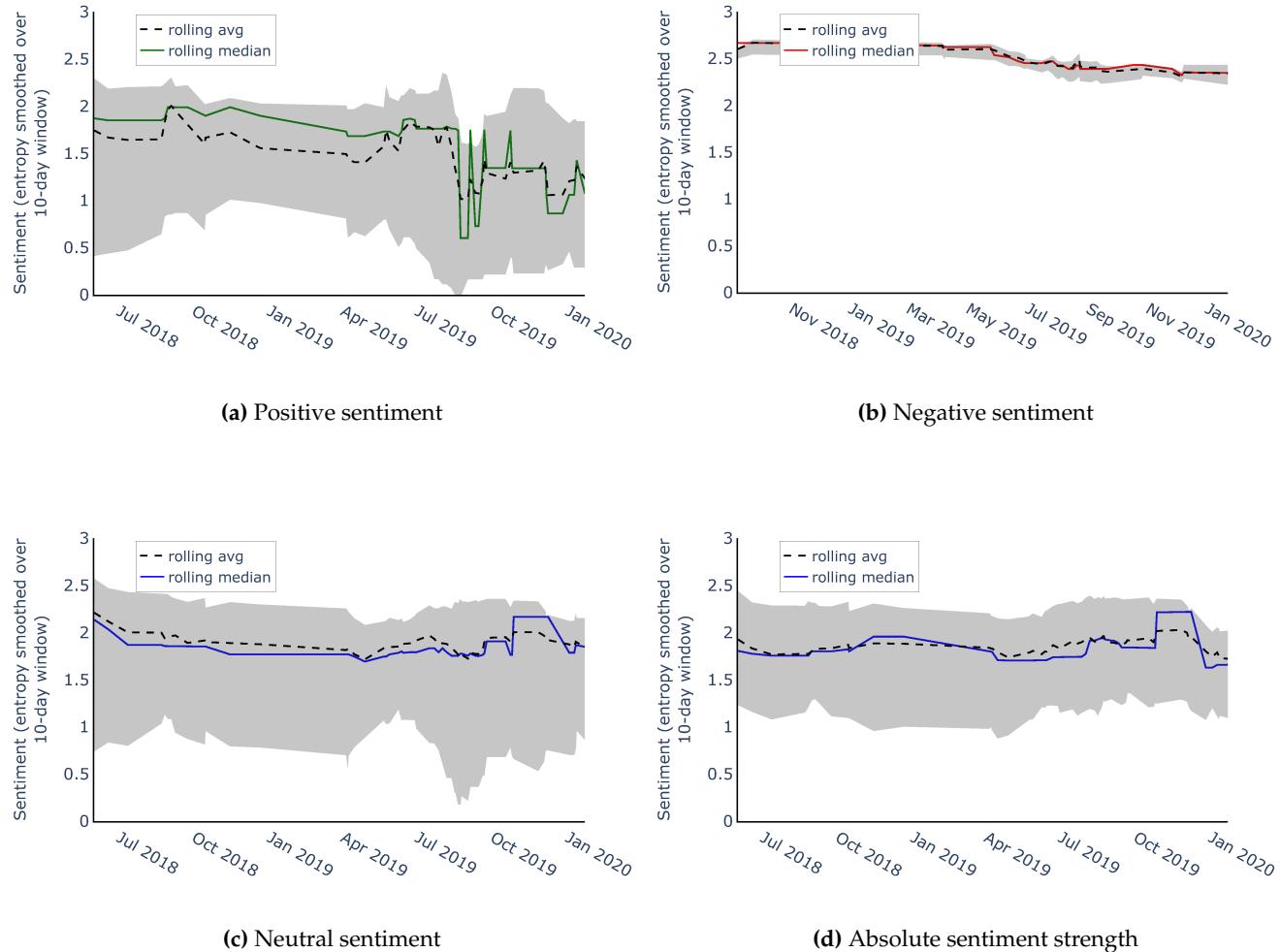


Figure 7. Cryptoslate LTC - Entropy sentiment index.

1 ENTROPY-BASED SENTIMENT INDICES

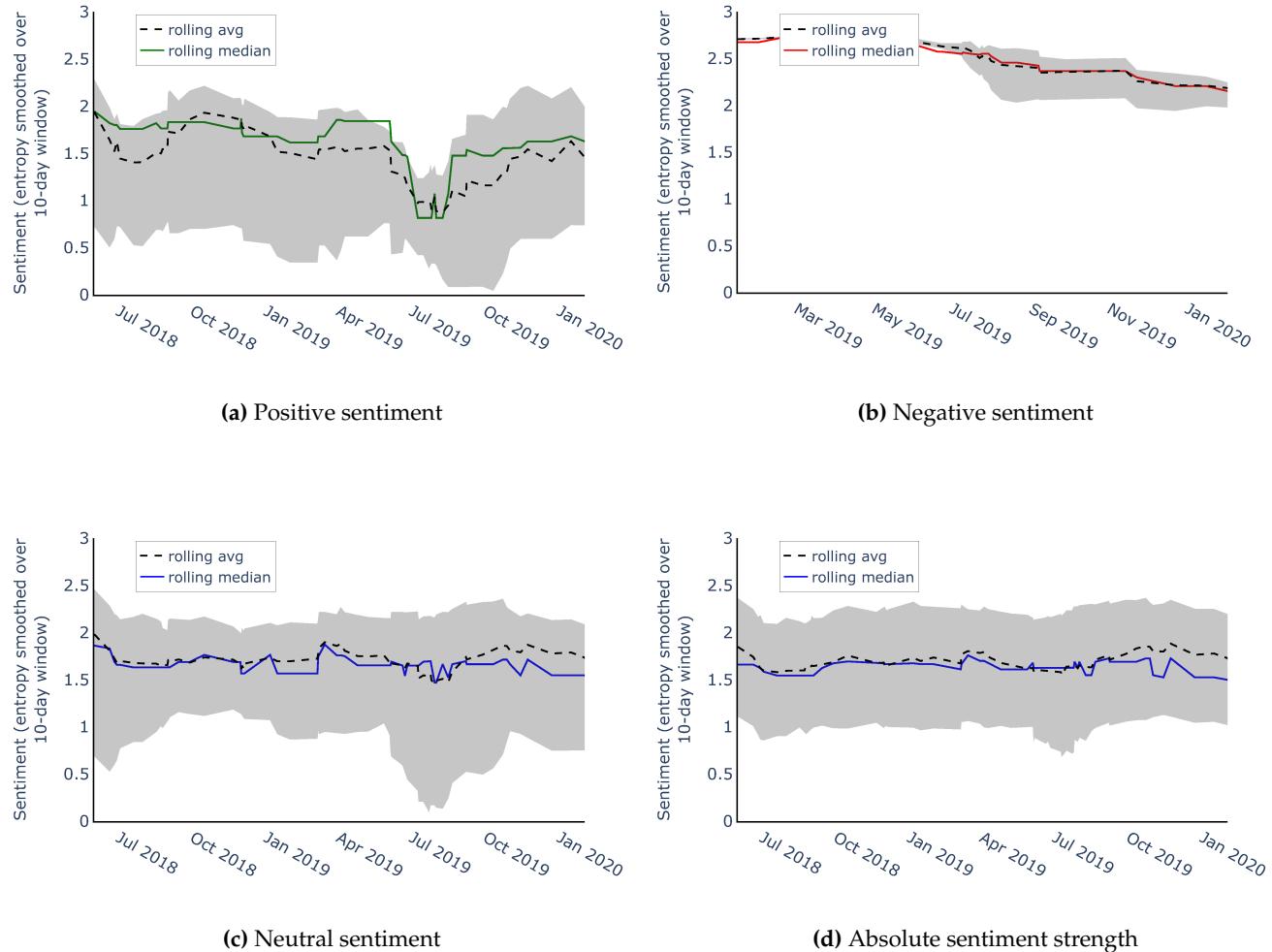


Figure 8. Cryptoslate TRX - Entropy sentiment index.

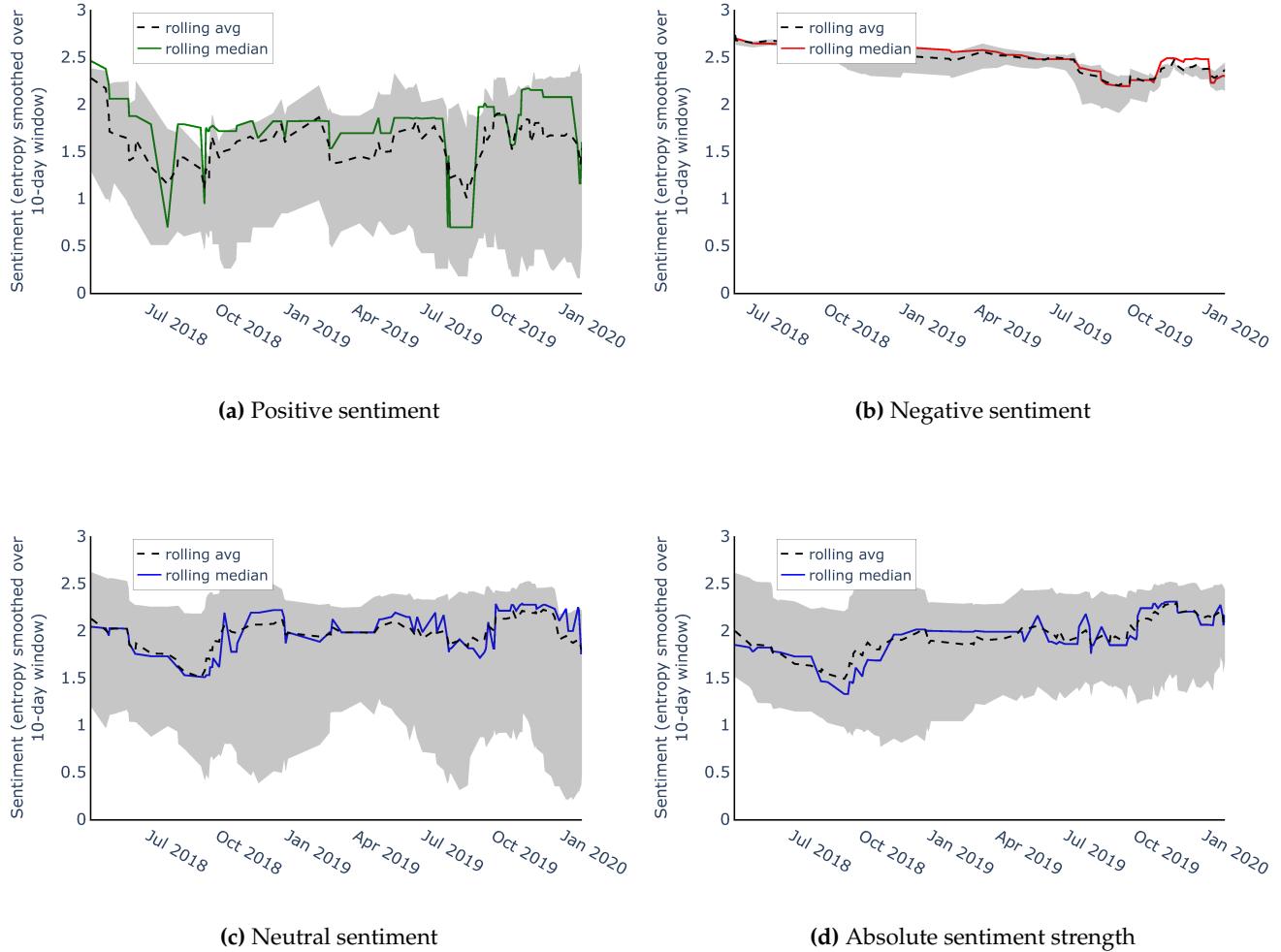


Figure 9. Cryptoslate XRP - Entropy sentiment index.

2. Two-sample t-test for equal means

The two-sample mean test ([Snedecor 1989](#)) is used to determine whether two population means are equal, and therefore helps us infer whether two sample sets may have come from the same population. The test assumes that i) observations are independent, ii) the two sample sets are independent, and iii) the two populations are normally distributed. The test is defined as follows:

$$\begin{aligned} H_0 : \quad & \mu_1 = \mu_2 \\ H_1 : \quad & \mu_1 \neq \mu_2 \end{aligned}, \tag{1}$$

and the test statistic is:

$$T = \frac{\bar{Y}_1 - \bar{Y}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}, \quad (2)$$

where N_1, N_2 are the sample sizes, \bar{Y}_1, \bar{Y}_2 are the sample means of the two sets of observations, and s_1^2, s_2^2 are the sample variances:

$$s_p^2 = \frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}, \quad (3)$$

for $p = 1, 2$.

With significance level α we reject the null hypothesis of means equality if $|T| > t_{1-\alpha/2, v}$, where $t_{1-\alpha/2, v}$ is the critical value of the t -Student distribution with v degrees of freedom, where:

$$v = \frac{\left(\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}\right)^2}{\frac{\left(\frac{s_1^2}{N_1}\right)^2}{N_1-1} + \frac{\left(\frac{s_2^2}{N_2}\right)^2}{N_2-1}}. \quad (4)$$

3. Crypto-specific vs general sentiment dictionary

In this section we perform two-sample mean tests between sentiment indices built using the crypto-specific dictionary we constructed and a general sentiment dictionary. We partitioned the data into yearly quarters and include the results in Tables 3 - 11.

Table 3. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	1.429069	0.156446	.
cryptodaily	BTC	pos	5.406016	0	****
cryptodaily	ETH	neg	0.318368	0.752655	.
cryptodaily	ETH	pos	0.981371	0.330224	.
cryptodaily	LTC	neg	-	-	-
cryptodaily	LTC	pos	-	-	-
cryptodaily	XRP	neg	-	-	-
cryptodaily	XRP	pos	-	-	-
cryptodaily	TRX	neg	-	-	-
cryptodaily	TRX	pos	-	-	-
cryptoslate	BTC	neg	3.174496	0.003955	****
cryptoslate	BTC	pos	3.932271	0.000335	****
cryptoslate	ETH	neg	0.006202	0.995292	.
cryptoslate	ETH	pos	2.766166	0.016035	***
cryptoslate	LTC	neg	-3.626963	0.171269	.
cryptoslate	LTC	pos	2.003371	0.183045	.
cryptoslate	XRP	neg	-0.822864	0.497084	.
cryptoslate	XRP	pos	-1.863900	0.099334	*
cryptoslate	TRX	neg	0.917847	0.527254	.
cryptoslate	TRX	pos	0.630384	0.641926	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 4. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q2-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	4.106347	8.7E-05	****
cryptodaily	BTC	pos	5.821306	0	****
cryptodaily	ETH	neg	-0.016777	0.986753	.
cryptodaily	ETH	pos	4.760249	1.2E-05	****
cryptodaily	LTC	neg	-0.244073	0.813317	.
cryptodaily	LTC	pos	3.305339	0.002867	****
cryptodaily	XRP	neg	-1.946965	0.059838	*
cryptodaily	XRP	pos	1.132777	0.260531	.
cryptodaily	TRX	neg	-0.995633	0.375780	.
cryptodaily	TRX	pos	0.184108	0.856569	.
cryptoslate	BTC	neg	2.594548	0.011174	***
cryptoslate	BTC	pos	4.817882	5E-06	****
cryptoslate	ETH	neg	1.201062	0.234969	.
cryptoslate	ETH	pos	5.357497	2E-06	****
cryptoslate	LTC	neg	1.818046	0.210685	.
cryptoslate	LTC	pos	2.199880	0.079106	*
cryptoslate	XRP	neg	-0.717925	0.491018	.
cryptoslate	XRP	pos	0.561517	0.581772	.
cryptoslate	TRX	neg	1.255238	0.336180	.
cryptoslate	TRX	pos	-0.442981	0.663364	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 5. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q3-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	6.592910	0	****
cryptodaily	BTC	pos	12.273987	0	****
cryptodaily	ETH	neg	2.237250	0.028201	**
cryptodaily	ETH	pos	3.836495	0.000222	****
cryptodaily	LTC	neg	0.299728	0.766598	*
cryptodaily	LTC	pos	5.876285	0	****
cryptodaily	XRP	neg	1.669309	0.099065	.
cryptodaily	XRP	pos	1.481204	0.141109	.
cryptodaily	TRX	neg	-1.501868	0.167376	.
cryptodaily	TRX	pos	1.967933	0.057039	*
cryptoslate	BTC	neg	6.570579	0	****
cryptoslate	BTC	pos	8.214479	0	****
cryptoslate	ETH	neg	2.681260	0.009352	****
cryptoslate	ETH	pos	5.676475	0	****
cryptoslate	LTC	neg	0.542014	0.616591	.
cryptoslate	LTC	pos	0.277069	0.786865	.
cryptoslate	XRP	neg	0.605058	0.555556	.
cryptoslate	XRP	pos	0.574524	0.571442	.
cryptoslate	TRX	neg	-	-	-
cryptoslate	TRX	pos	0.039029	0.969418	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 6. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q4-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	4.105561	9.4E-05	****
cryptodaily	BTC	pos	6.819732	0	****
cryptodaily	ETH	neg	0.817327	0.417955	.
cryptodaily	ETH	pos	4.630611	1.6E-05	****
cryptodaily	LTC	neg	0.305149	0.772547	.
cryptodaily	LTC	pos	2.090922	0.056739	*
cryptodaily	XRP	neg	1.005231	0.319188	.
cryptodaily	XRP	pos	1.785454	0.078582	*
cryptodaily	TRX	neg	-2.308533	0.041406	**
cryptodaily	TRX	pos	-0.530727	0.598107	.
cryptoslate	BTC	neg	4.157188	8.1E-05	****
cryptoslate	BTC	pos	3.484034	0.000706	****
cryptoslate	ETH	neg	1.466432	0.154082	.
cryptoslate	ETH	pos	1.319815	0.194592	.
cryptoslate	LTC	neg	-	-	-
cryptoslate	LTC	pos	2.518812	0.086267	*
cryptoslate	XRP	neg	1.025443	0.327177	.
cryptoslate	XRP	pos	0.117234	0.907692	.
cryptoslate	TRX	neg	-0.134146	0.915107	.
cryptoslate	TRX	pos	-0.310743	0.761805	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 7. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	3.552227	0.000495	****
cryptodaily	BTC	pos	13.386894	0	****
cryptodaily	ETH	neg	1.779522	0.079829	*
cryptodaily	ETH	pos	7.634575	0	****
cryptodaily	LTC	neg	0.686628	0.498637	.
cryptodaily	LTC	pos	6.118749	0	****
cryptodaily	XRP	neg	1.600904	0.112241	.
cryptodaily	XRP	pos	3.927351	0.000152	****
cryptodaily	TRX	neg	-2.088639	0.052092	*
cryptodaily	TRX	pos	-0.708000	0.480977	.
cryptoslate	BTC	neg	4.866477	1.6E-05	****
cryptoslate	BTC	pos	5.837026	0	****
cryptoslate	ETH	neg	2.304898	0.032021	**
cryptoslate	ETH	pos	2.185568	0.035832	**
cryptoslate	LTC	neg	-	-	-
cryptoslate	LTC	pos	-	-	-
cryptoslate	XRP	neg	-	-	-
cryptoslate	XRP	pos	2.170792	0.072982	*
cryptoslate	TRX	neg	-0.481104	0.655576	.
cryptoslate	TRX	pos	0.198756	0.845529	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 8. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q2-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	7.985339	0	****
cryptodaily	BTC	pos	16.300749	0	****
cryptodaily	ETH	neg	5.668522	0	****
cryptodaily	ETH	pos	13.963534	0	****
cryptodaily	LTC	neg	3.908406	0.00023	****
cryptodaily	LTC	pos	6.829077	0	****
cryptodaily	XRP	neg	0.380399	0.704725	.
cryptodaily	XRP	pos	1.117180	0.266308	.
cryptodaily	TRX	neg	-1.504621	0.153185	.
cryptodaily	TRX	pos	1.201245	0.236387	.
cryptoslate	BTC	neg	6.611394	0	****
cryptoslate	BTC	pos	4.172550	6.8E-05	****
cryptoslate	ETH	neg	2.431402	0.021694	***
cryptoslate	ETH	pos	2.977781	0.004208	****
cryptoslate	LTC	neg	2.5323801	0.03211	**
cryptoslate	LTC	pos	1.814112	0.081681	*
cryptoslate	XRP	neg	0.868240	0.414036	.
cryptoslate	XRP	pos	0.971512	0.3467	.
cryptoslate	TRX	neg	0.165810	0.872420	.
cryptoslate	TRX	pos	1.523371	0.146051	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 9. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q3-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	7.555919	0	****
cryptodaily	BTC	pos	16.707469	0	****
cryptodaily	ETH	neg	5.317440	0	****
cryptodaily	ETH	pos	10.034719	0	****
cryptodaily	LTC	neg	1.956519	0.05842	*
cryptodaily	LTC	pos	4.148419	0.000147	****
cryptodaily	XRP	neg	0.289368	0.775278	.
cryptodaily	XRP	pos	2.345724	0.022764	***
cryptodaily	TRX	neg	0.276219	0.785526	.
cryptodaily	TRX	pos	1.768416	0.088290	*
cryptoslate	BTC	neg	8.193491	0	****
cryptoslate	BTC	pos	5.4296	0	****
cryptoslate	ETH	neg	1.362396	0.180511	.
cryptoslate	ETH	pos	4.308277	5.2E-05	****
cryptoslate	LTC	neg	2.079247	0.048007	**
cryptoslate	LTC	pos	2.015777	0.052285	*
cryptoslate	XRP	neg	3.046167	0.006645	****
cryptoslate	XRP	pos	1.665463	0.107826	.
cryptoslate	TRX	neg	-0.906134	0.376213	.
cryptoslate	TRX	pos	0.618	0.542165	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'.

Table 10. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q4-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	6.824855	0	****
cryptodaily	BTC	pos	14.745228	0	****
cryptodaily	ETH	neg	3.744832	0.00025	****
cryptodaily	ETH	pos	11.872916	0	****
cryptodaily	LTC	neg	0.823176	0.422508	.
cryptodaily	LTC	pos	4.432148	0.000109	****
cryptodaily	XRP	neg	0.431257	0.672848	.
cryptodaily	XRP	pos	3.005963	0.004407	****
cryptodaily	TRX	neg	0.431374	0.684163	.
cryptodaily	TRX	pos	1.729193	0.111699	.
cryptoslate	BTC	neg	5.316130	1E-06	****
cryptoslate	BTC	pos	5.907668	0	****
cryptoslate	ETH	neg	1.224606	0.225943	.
cryptoslate	ETH	pos	3.55417	0.000644	****
cryptoslate	LTC	neg	1.213617	0.259506	.
cryptoslate	LTC	pos	3.090604	0.007017	****
cryptoslate	XRP	neg	1.639846	0.111147	.
cryptoslate	XRP	pos	1.580073	0.122379	.
cryptoslate	TRX	neg	1.784428	0.148914	.
cryptoslate	TRX	pos	0.100147	0.922029	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 11. Hypothesis testing using the sample means of the sentiment indices constructed with non crypto-specific lists of positive/negative words. Reference for the tests is the sentiment entropy construction based on the crypto-specific dictionary, and it is compared against the corresponding - in terms of news source, asset and sentiment type - entropy construction based on the general, non crypto-specific sentiment lists. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2020		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	2.626585	0.01136	***
cryptodaily	BTC	pos	9.091676	0	****
cryptodaily	ETH	neg	2.638401	0.011474	***
cryptodaily	ETH	pos	6.623827	0	****
cryptodaily	LTC	neg	0.731047	0.483348	.
cryptodaily	LTC	pos	1.943886	0.066113	*
cryptodaily	XRP	neg	-0.123966	0.904067	.
cryptodaily	XRP	pos	0.817888	0.423059	.
cryptodaily	TRX	neg	-	-	-
cryptodaily	TRX	pos	0.117399	0.909841	.
cryptoslate	BTC	neg	5.699501	2E-06	****
cryptoslate	BTC	pos	5.276818	5E-06	****
cryptoslate	ETH	neg	2.987232	0.010493	***
cryptoslate	ETH	pos	2.552381	0.017483	***
cryptoslate	LTC	neg	2.348495	0.256273	.
cryptoslate	LTC	pos	4.467944	0.011092	***
cryptoslate	XRP	neg	1.293800	0.236785	.
cryptoslate	XRP	pos	1.848458	0.097590	*
cryptoslate	TRX	neg	-	-	-
cryptoslate	TRX	pos	-	-	-

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

4. Comparison between sentiment types and absolute sentiment strength

In this section we investigate whether it is meaningful to construct and study polarity-specific sentiment indices as opposed to a general index capturing the sentiment magnitude. We perform again a series of two-sample mean tests for yearly quarters between the index of sentiment magnitude and the polarity-specific sentiments for the corresponding assets and news sources. The results are presented in Tables 12 - 20.

Table 12. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	10.641833	0	****
cryptodaily	BTC	pos	-2.315078	0.022652	***
cryptodaily	BTC	neutral	-0.324002	0.746367	.
cryptodaily	ETH	neg	10.683353	0	****
cryptodaily	ETH	pos	1.818655	0.074041	.
cryptodaily	ETH	neutral	0.229138	0.819265	.
cryptodaily	LTC	neg	-	-	-
cryptodaily	LTC	pos	-	-	-
cryptodaily	LTC	neutral	-	-	-
cryptodaily	XRP	neg	-	-	-
cryptodaily	XRP	pos	-	-	-
cryptodaily	XRP	neutral	-	-	-
cryptodaily	TRX	neg	-	-	-
cryptodaily	TRX	pos	-	-	-
cryptodaily	TRX	neutral	-	-	-
cryptoslate	BTC	neg	6.600032	0	****
cryptoslate	BTC	pos	-2.990754	0.005627	****
cryptoslate	BTC	neutral	0.544537	0.589021	.
cryptoslate	ETH	neg	8.579314	0	****
cryptoslate	ETH	pos	-1.487951	0.157483	.
cryptoslate	ETH	neutral	1.860711	0.074587	*
cryptoslate	LTC	neg	3.229081	0.083998	*
cryptoslate	LTC	pos	-0.996380	0.424046	.
cryptoslate	LTC	neutral	0.708072	0.529957	.
cryptoslate	XRP	neg	5.930214	0.001026	****
cryptoslate	XRP	pos	4.432666	0.001641	****
cryptoslate	XRP	neutral	1.677582	0.127741	.
cryptoslate	TRX	neg	2.870118	0.213436	.
cryptoslate	TRX	pos	-0.598900	0.656473	.
cryptoslate	TRX	neutral	0.615572	0.648719	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 13. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q2-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	7.534707	0	****
cryptodaily	BTC	pos	-1.940111	0.054858	*
cryptodaily	BTC	neutral	-0.626014	0.532304	.
cryptodaily	ETH	neg	10.125407	0	****
cryptodaily	ETH	pos	-0.507438	0.613953	.
cryptodaily	ETH	neutral	0.514840	0.607860	.
cryptodaily	LTC	neg	9.313289	0	****
cryptodaily	LTC	pos	-0.765527	0.451743	.
cryptodaily	LTC	neutral	0.564776	0.574702	.
cryptodaily	XRP	neg	10.249284	0	****
cryptodaily	XRP	pos	0.774309	0.441150	.
cryptodaily	XRP	neutral	-0.026819	0.978648	.
cryptodaily	TRX	neg	8.688058	0	****
cryptodaily	TRX	pos	0.105564	0.918528	.
cryptodaily	TRX	neutral	0.255988	0.799010	.
cryptoslate	BTC	neg	7.845532	0	****
cryptoslate	BTC	pos	-4.119896	9.8E-05	****
cryptoslate	BTC	neutral	0.900811	0.369605	.
cryptoslate	ETH	neg	10.021316	0	****
cryptoslate	ETH	pos	-3.338181	0.001678	****
cryptoslate	ETH	neutral	0.253166	0.800852	.
cryptoslate	LTC	neg	5.887914	0.001065	****
cryptoslate	LTC	pos	0.470794	0.652105	.
cryptoslate	LTC	neutral	1.138079	0.284476	.
cryptoslate	XRP	neg	8.236484	1E-06	****
cryptoslate	XRP	pos	-0.655604	0.524449	.
cryptoslate	XRP	neutral	0.523263	0.607545	.
cryptoslate	TRX	neg	10.567624	0.008836	****
cryptoslate	TRX	pos	0.420403	0.684051	.
cryptoslate	TRX	neutral	1.859127	0.085788	*

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 14. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q3-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	11.721715	0	****
cryptodaily	BTC	pos	-8.501452	0	****
cryptodaily	BTC	neutral	-1.329893	0.185470	.
cryptodaily	ETH	neg	8.793042	0	****
cryptodaily	ETH	pos	-3.543208	0.000689	****
cryptodaily	ETH	neutral	-0.163968	0.870065	.
cryptodaily	LTC	neg	11.500968	0	****
cryptodaily	LTC	pos	-1.605290	0.116106	.
cryptodaily	LTC	neutral	1.162953	0.249036	.
cryptodaily	XRP	neg	6.863149	0	****
cryptodaily	XRP	pos	-3.071675	0.002723	****
cryptodaily	XRP	neutral	0.028704	0.977146	.
cryptodaily	TRX	neg	10.226999	0	****
cryptodaily	TRX	pos	-1.653545	0.109802	.
cryptodaily	TRX	neutral	1.434589	0.158638	.
cryptoslate	BTC	neg	7.009608	0	****
cryptoslate	BTC	pos	-7.791775	0	****
cryptoslate	BTC	neutral	-0.025721	0.979512	.
cryptoslate	ETH	neg	7.280197	0	****
cryptoslate	ETH	pos	-5.369894	1E-06	****
cryptoslate	ETH	neutral	-0.136698	0.891509	.
cryptoslate	LTC	neg	4.602630	0.002476	****
cryptoslate	LTC	pos	-0.128633	0.901266	.
cryptoslate	LTC	neutral	-0.111957	0.913315	.
cryptoslate	XRP	neg	5.171728	6.4E-05	****
cryptoslate	XRP	pos	-1.291551	0.212852	.
cryptoslate	XRP	neutral	1.079164	0.291702	.
cryptoslate	TRX	neg	-	-	-
cryptoslate	TRX	pos	0.298150	0.770301	.
cryptoslate	TRX	neutral	1.093200	0.287973	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 15. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q4-2018		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	10.693057	0	****
cryptodaily	BTC	pos	-4.418375	3.6E-05	****
cryptodaily	BTC	neutral	-0.667590	0.505375	.
cryptodaily	ETH	neg	6.379774	0	****
cryptodaily	ETH	pos	-3.030663	0.004121	****
cryptodaily	ETH	neutral	0.439905	0.660846	.
cryptodaily	LTC	neg	4.584796	0.005922	****
cryptodaily	LTC	pos	-2.554974	0.030941	**
cryptodaily	LTC	neutral	1.289466	0.207426	.
cryptodaily	XRP	neg	8.641615	0	****
cryptodaily	XRP	pos	-1.986935	0.052653	*
cryptodaily	XRP	neutral	0.786392	0.433080	.
cryptodaily	TRX	neg	17.234897	0	****
cryptodaily	TRX	pos	2.100389	0.04257	**
cryptodaily	TRX	neutral	0.537325	0.592447	.
cryptoslate	BTC	neg	4.203390	7.3E-05	****
cryptoslate	BTC	pos	-5.855080	0	****
cryptoslate	BTC	neutral	-0.270047	0.787630	.
cryptoslate	ETH	neg	3.688316	0.001048	****
cryptoslate	ETH	pos	-3.388462	0.002173	****
cryptoslate	ETH	neutral	0.044100	0.965039	.
cryptoslate	LTC	neg	-	-	-
cryptoslate	LTC	pos	-1.268967	0.293964	.
cryptoslate	LTC	neutral	-0.356710	0.735868	.
cryptoslate	XRP	neg	4.148661	0.000546	****
cryptoslate	XRP	pos	-1.661288	0.117408	.
cryptoslate	XRP	neutral	0.783944	0.441072	.
cryptoslate	TRX	neg	5.463700	0.002795	****
cryptoslate	TRX	pos	0.808141	0.436138	.
cryptoslate	TRX	neutral	-0.097533	0.924058	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 16. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	8.640779	0	****
cryptodaily	BTC	pos	-10.592325	0	****
cryptodaily	BTC	neutral	-2.585587	0.01063	***
cryptodaily	ETH	neg	5.566975	0	****
cryptodaily	ETH	pos	-6.874193	0	****
cryptodaily	ETH	neutral	0.228952	0.819356	.
cryptodaily	LTC	neg	7.092917	0	****
cryptodaily	LTC	pos	-3.204204	0.002742	****
cryptodaily	LTC	neutral	-0.019940	0.984166	.
cryptodaily	XRP	neg	6.056434	0	****
cryptodaily	XRP	pos	-5.214639	1E-06	****
cryptodaily	XRP	neutral	-0.709760	0.479059	.
cryptodaily	TRX	neg	8.571988	2E-06	****
cryptodaily	TRX	pos	0.827885	0.410261	.
cryptodaily	TRX	neutral	1.222383	0.225108	.
cryptoslate	BTC	neg	3.239880	0.002129	****
cryptoslate	BTC	pos	-5.484374	2E-06	****
cryptoslate	BTC	neutral	-0.116075	0.907921	.
cryptoslate	ETH	neg	2.993668	0.007792	****
cryptoslate	ETH	pos	-4.017097	0.000676	****
cryptoslate	ETH	neutral	-0.439452	0.663115	.
cryptoslate	LTC	neg	-	-	-
cryptoslate	LTC	pos	-	-	-
cryptoslate	LTC	neutral	-	-	-
cryptoslate	XRP	neg	3.281341	0.013462	***
cryptoslate	XRP	pos	-1.751312	0.130454	.
cryptoslate	XRP	neutral	-0.132990	0.896603	.
cryptoslate	TRX	neg	4.966634	0.00767	****
cryptoslate	TRX	pos	-1.258960	0.243537	.
cryptoslate	TRX	neutral	0.758245	0.461830	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 17. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q2-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	1.135229	0.257998	.
cryptodaily	BTC	pos	-16.087715	0	****
cryptodaily	BTC	neutral	-6.475668	0	****
cryptodaily	ETH	neg	-5.635428	0	****
cryptodaily	ETH	pos	-24.744032	0	****
cryptodaily	ETH	neutral	-7.308446	0	****
cryptodaily	LTC	neg	-3.466728	0.00087	****
cryptodaily	LTC	pos	-10.324524	0	****
cryptodaily	LTC	neutral	-2.905495	0.004673	****
cryptodaily	XRP	neg	4.681321	1.5E-05	****
cryptodaily	XRP	pos	-4.587002	1.9E-05	****
cryptodaily	XRP	neutral	-1.952214	0.054368	*
cryptodaily	TRX	neg	10.622930	0	****
cryptodaily	TRX	pos	-1.703340	0.099581	*
cryptodaily	TRX	neutral	-0.545200	0.588643	.
cryptoslate	BTC	neg	4.166216	8.3E-05	****
cryptoslate	BTC	pos	-5.080829	4E-06	****
cryptoslate	BTC	neutral	-0.877422	0.382568	.
cryptoslate	ETH	neg	5.053978	1.5E-05	****
cryptoslate	ETH	pos	-2.845659	0.006957	****
cryptoslate	ETH	neutral	-0.129632	0.897299	.
cryptoslate	LTC	neg	5.949725	3.5E-05	****
cryptoslate	LTC	pos	-0.115532	0.909303	.
cryptoslate	LTC	neutral	0.335543	0.740015	.
cryptoslate	XRP	neg	4.132839	0.001015	****
cryptoslate	XRP	pos	-0.917045	0.373629	.
cryptoslate	XRP	neutral	0.128996	0.898717	.
cryptoslate	TRX	neg	14.633198	0	****
cryptoslate	TRX	pos	-2.264102	0.044769	**
cryptoslate	TRX	neutral	0.612487	0.547477	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 18. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q3-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	3.029225	0.002894	****
cryptodaily	BTC	pos	-17.732576	0	****
cryptodaily	BTC	neutral	-6.529322	0	****
cryptodaily	ETH	neg	-5.989146	0	****
cryptodaily	ETH	pos	-19.672092	0	****
cryptodaily	ETH	neutral	-5.771005	0	****
cryptodaily	LTC	neg	0.720793	0.475566	.
cryptodaily	LTC	pos	-6.595848	0	****
cryptodaily	LTC	neutral	-2.116320	0.041718	**
cryptodaily	XRP	neg	1.863855	0.069694	*
cryptodaily	XRP	pos	-2.970410	0.004673	****
cryptodaily	XRP	neutral	-0.667282	0.506884	.
cryptodaily	TRX	neg	7.693279	0	****
cryptodaily	TRX	pos	-3.035543	0.008346	****
cryptodaily	TRX	neutral	0.974716	0.337246	.
cryptoslate	BTC	neg	5.658285	0	****
cryptoslate	BTC	pos	-7.689339	0	****
cryptoslate	BTC	neutral	-0.581664	0.561690	.
cryptoslate	ETH	neg	5.664626	1E-06	****
cryptoslate	ETH	pos	-3.554491	0.000904	****
cryptoslate	ETH	neutral	-0.879762	0.382042	.
cryptoslate	LTC	neg	5.322660	9E-06	****
cryptoslate	LTC	pos	-2.930358	0.008273	****
cryptoslate	LTC	neutral	-1.063914	0.295091	.
cryptoslate	XRP	neg	0.995744	0.330201	.
cryptoslate	XRP	pos	-2.055517	0.052475	*
cryptoslate	XRP	neutral	-0.253116	0.801850	.
cryptoslate	TRX	neg	6.912847	1E-06	****
cryptoslate	TRX	pos	-3.540552	0.00272	****
cryptoslate	TRX	neutral	-0.604319	0.551813	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 19. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q4-2019		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	1.027069	0.306009	.
cryptodaily	BTC	pos	-21.129012	0	****
cryptodaily	BTC	neutral	-8.092790	0	****
cryptodaily	ETH	neg	-6.806680	0	****
cryptodaily	ETH	pos	-23.702121	0	****
cryptodaily	ETH	neutral	-9.862608	0	****
cryptodaily	LTC	neg	0.638469	0.528013	.
cryptodaily	LTC	pos	-6.538084	1E-06	****
cryptodaily	LTC	neutral	-0.144993	0.885548	.
cryptodaily	XRP	neg	3.190948	0.00324	****
cryptodaily	XRP	pos	-3.512948	0.001214	****
cryptodaily	XRP	neutral	-0.405001	0.687107	.
cryptodaily	TRX	neg	2.233116	0.066978	*
cryptodaily	TRX	pos	-2.858707	0.021193	***
cryptodaily	TRX	neutral	0.890724	0.389265	.
cryptoslate	BTC	neg	6.110745	0	****
cryptoslate	BTC	pos	-7.929279	0	****
cryptoslate	BTC	neutral	-1.399531	0.163835	.
cryptoslate	ETH	neg	4.231589	8.2E-05	****
cryptoslate	ETH	pos	-5.411332	2E-06	****
cryptoslate	ETH	neutral	-1.125972	0.263916	.
cryptoslate	LTC	neg	2.993743	0.010363	***
cryptoslate	LTC	pos	-2.740622	0.015936	***
cryptoslate	LTC	neutral	-0.207919	0.837763	.
cryptoslate	XRP	neg	2.302189	0.028204	**
cryptoslate	XRP	pos	-3.468394	0.001992	****
cryptoslate	XRP	neutral	-1.139770	0.261909	.
cryptoslate	TRX	neg	0.958531	0.381817	.
cryptoslate	TRX	pos	-0.351039	0.732842	.
cryptoslate	TRX	neutral	0.164738	0.872139	.

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

Table 20. Hypothesis testing on the sample means of the sentiment indices constructed with crypto-specific positive, negative and neutral words. Reference for all tests is the entropy construction of the corresponding news source and asset where the support of the distribution does not depend on sentiment type and the dictionary includes all crypto-specific terms. The dashed cells represent lack of data for that period for one of the two samples.

News source	Asset	Sentiment index	Q1-2020		
			Test statistic	p-value	Significance
cryptodaily	BTC	neg	-0.575207	0.568149	.
cryptodaily	BTC	pos	-11.242996	0	****
cryptodaily	BTC	neutral	-3.322447	0.001549	****
cryptodaily	ETH	neg	-4.252921	0.000163	****
cryptodaily	ETH	pos	-11.361788	0	****
cryptodaily	ETH	neutral	-4.939282	1.3E-05	****
cryptodaily	LTC	neg	1.337813	0.197616	.
cryptodaily	LTC	pos	-3.562384	0.001952	****
cryptodaily	LTC	neutral	-0.196486	0.846119	.
cryptodaily	XRP	neg	0.851766	0.411020	.
cryptodaily	XRP	pos	-1.915354	0.076101	*
cryptodaily	XRP	neutral	-0.061853	0.951326	.
cryptodaily	TRX	neg	-	-	-
cryptodaily	TRX	pos	-0.992112	0.354191	.
cryptodaily	TRX	neutral	-0.089519	0.932145	.
cryptoslate	BTC	neg	2.782431	0.008854	****
cryptoslate	BTC	pos	-3.290104	0.002501	****
cryptoslate	BTC	neutral	-0.308345	0.759006	.
cryptoslate	ETH	neg	1.547257	0.139203	.
cryptoslate	ETH	pos	-1.891938	0.076740	*
cryptoslate	ETH	neutral	-1.915542	0.066929	*
cryptoslate	LTC	neg	2.152673	0.164223	.
cryptoslate	LTC	pos	-1.913857	0.104149	.
cryptoslate	LTC	neutral	-0.431265	0.679245	.
cryptoslate	XRP	neg	1.380655	0.192559	.
cryptoslate	XRP	pos	-2.198298	0.059151	*
cryptoslate	XRP	neutral	-0.473572	0.642624	.
cryptoslate	TRX	neg	-	-	-
cryptoslate	TRX	pos	-	-	-
cryptoslate	TRX	neutral	-	-	-

Significance codes: '****' 0.01 '***' 0.025 '**' 0.05 '*' 0.1 '.'

5. Interpretation of sentiment indices

The transparent way in which we constructed the sentiment indices endows them with the ability to be interpreted in terms of the articles that caused a certain sentiment signal, as well as in terms of author and news sources reporting biases. In the following sections we demonstrate how to achieve this, as well as what useful insights investors may draw from this type of analysis.

5.1. Article information from sentiment indices

In this section we decompose each sentiment index for all assets (BTC, ETH, LTC, TRX, XRP) and news sources (Cryptodaily, Cryptoslate) with respect to the articles that drive their evolution. The method we employed is detailed in Algorithm 2, and we present the results in Figures 10 - 49 and the corresponding Tables 21 - 100.

```

Input : time-series of cumulative recursive proportions  $\{X_t\}$  that the sentiment index is based on, list  $M$  of metadata  

    (author, article title, publication date) for each  $n$ -gram of  $\{X_t\}$ , set  $Q = \{q_0, \dots, q_p\}$  of quantile levels of the  

    distribution that the entropy was extracted from, which we consider are of interest for our analysis, quantile level  

 $q_s$  which we consider as determining the area of the most significant articles
Output : lists of 20 articles with the strongest and 20 articles with the weakest (per day) effect on the index,  $A_s, A_l$   

    respectively
Initialisation: group the  $n$ -gram values of  $\{X_t\}$  per day:  $D = \left\{ \{X_{i,t}\}_{i=1}^{d_t}, \dots, \{X_{i,T}\}_{i=1}^{d_T} \right\}$ ,  $Y = \emptyset$ 
for  $t \leftarrow t_1$  to  $T$  do
    density $_t$   $\leftarrow$  construct density of  $\{X_{i,t}\}_{i=1}^{d_t}$ ;
    for  $q \leftarrow q_0$  to  $q_p$  do
         $q_{\text{val}} \leftarrow$  compute  $q$ -th quantile of density $_t$ ;
         $q_{\text{idx}} \leftarrow \{j : X_{j,t} \geq q_{\text{val}}\}$ ;
        // use  $j$  to extract article title, date and author for the corresponding  $n$ -grams from  $M$ 
         $Y[t, q] = M[j]$ ;
    end
    // sort  $Y[t, q_s]$ 
     $A_s[t] \leftarrow$  top-20 elements of  $Y[t, q_s]$ ;
     $A_l[t] \leftarrow$  bottom-20 elements of  $Y[t, q_s]$ 
end

```

Algorithm 2: Identify most influential articles for given entropy-based sentiment index.

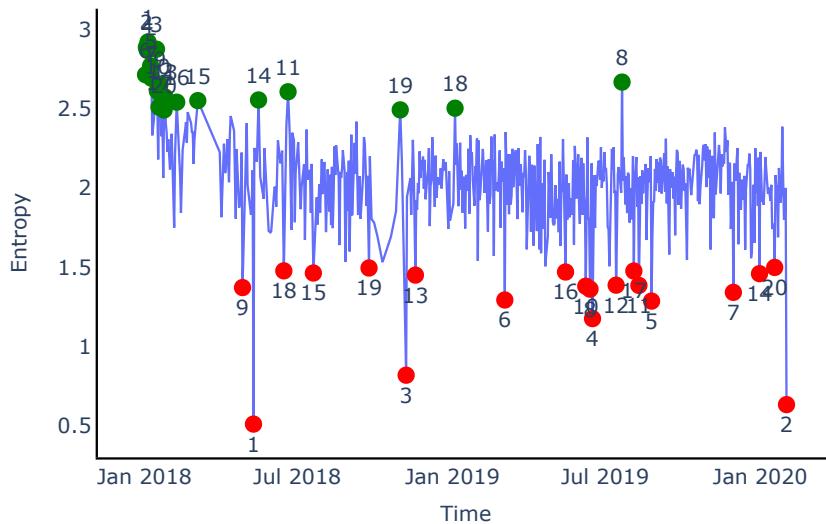


Figure 10. Top-20 articles that caused the strongest and lowest negative sentiment - Cryptodaily BTC

Table 21. Cryptodaily BTC - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-01-05	Frankie Crowhurst – Determine The True Value Of Cryptocurrencies Using These Five Indicators
2	2018-01-03	Frankie Crowhurst – Bitcoin Accounts Frozen By Australia Banks
3	2018-01-15	Frankie Crowhurst – Top Cryptocurrency Risks
4	2018-01-04	Denis Vinokourov – From the Las Vegas strip to blockchain code. SP8DE ICO is coming...
5	2018-01-08	Frankie Crowhurst – A Cryptocurrency Crime Wave Could Soon Be Hitting Us
6	2018-01-02	Frankie Crowhurst – 5 Blockchain Predictions For 2018
7	2018-01-09	Frankie Crowhurst – Mufti says Bitcoin is forbidden
8	2019-07-21	Sally Ho – Sally Ho's Technical Analysis 21 July 2019
9	2018-01-19	Frankie Crowhurst – What An Actual Crypto Crash Would Look Like
10	2018-01-16	Frankie Crowhurst – Is Indonesia About To Ban Bitcoin?
11	2018-06-20	Robert Johnson – Kenya Has Its First Bitcoin ATM
12	2018-01-20	Frankie Crowhurst – Here's Why The Crypto Crash Happened
13	2018-01-25	Frankie Crowhurst – Does Bitcoin Use Too Much Energy?
14	2018-05-16	Jefe Caan – Why Is Bitcoin (BTC) Falling Despite Consensus Excitement?
15	2018-03-05	Nathan Bentley – Criptomoneda Mexico's Move For Regulation
16	2018-02-08	Jessica Whitley – Millennials Love Bitcoin And Hate Stocks
17	2018-01-18	Frankie Crowhurst – Visa CEO Won't Process Transactions In Bitcoin
18	2019-01-04	Jefe Caan – S&P 500 Future Outlook Hints At Green Months For Bitcoin (BTC) Ahead
19	2018-10-31	Kyle Torpey – The Lightning Network Is Steroids For Bitcoin's Network Effects
20	2018-01-24	Frankie Crowhurst – Bitcoin Traders Forced To Identify Themselves

Table 22. Cryptodaily BTC - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-05-10	Devin Milsom – Is Holding Bitcoin REALLY Worth It?
2	2020-02-01	Sally Ho – Sally Ho's Technical Analysis 1 February 2020 BTC ETH
3	2018-11-07	Adrian Barkley – Why We Might Be Waiting A While For The Bitcoin ETF
4	2019-06-16	Jefe Caan – Bitcoin (BTC): Why This Could Be The Most Important Week Since Dec 2018
5	2019-08-25	Sally Ho – Sally Ho's Technical Analysis 25 August 2019
6	2019-03-04	Jefe Caan – Bitcoin (BTC) Tests Critical Support Price Eyes A Rally Towards \$4000
7	2019-11-30	Sally Ho – Sally Ho's Technical Analysis 30 November 2019
8	2019-06-13	Jefe Caan – Dollar Currency Index (DXY) Points To Bleak Bitcoin (BTC) Outlook Long Term
9	2018-04-27	Nathan Bentley – The Crypto Refresh April 27th
10	2019-06-08	Sally Ho – Sally Ho's Technical Analysis 8 June 2019
11	2019-08-10	Jefe Caan – Why Bitcoin (BTC) Broke Below The Pennant And What Happens Next
12	2019-07-14	Jefe Caan – Bitcoin (BTC) Bulls Have Lost Control Of The Price The Next Downtrend Begins
13	2018-11-18	Jefe Caan – Bitcoin (BTC) All Set For A Final More Devastating Fall
14	2019-12-31	Sally Ho – Sally Ho's Technical Analysis 31 December 2019 BTC ETH
15	2018-07-20	Jefe Caan – Bitcoin (BTC) ETF FOMO Likely To Suppress Upcoming Altcoin Rally
16	2019-05-15	Jefe Caan – Bitcoin (BTC) Rally Likely To End Badly As S&P 500 Points To Gloomy Outlook
17	2019-08-04	Adrian Barkley – \$470 Million BTC Moved By Whale
18	2018-06-15	Thomas Ramsay – Mastercard Wants Bitcoin But Not For The Reasons You Might Think
19	2018-09-24	Jefe Caan – Can Bitcoin (BTC) Fall Below \$6000 Again?
20	2020-01-18	Javier Solorio – BCH and BSV Halving Could Be The End Of The World For Miners

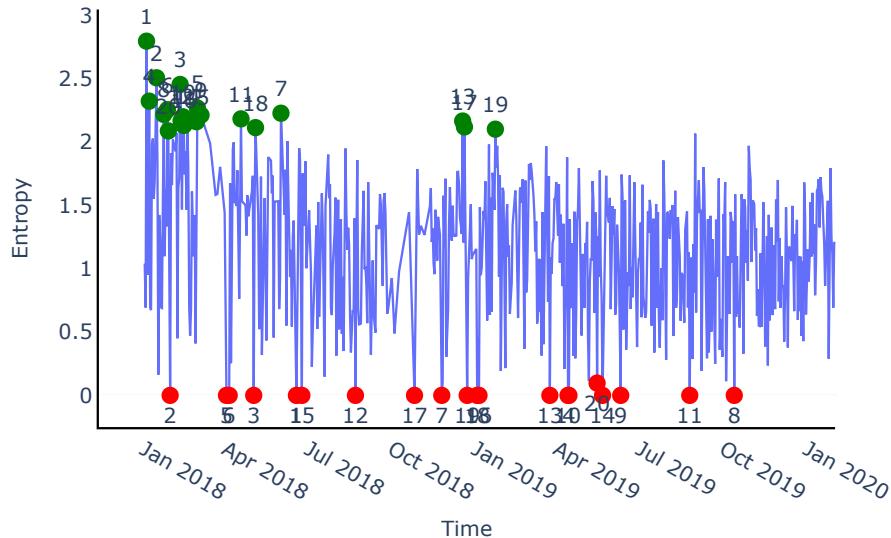


Table 24. Cryptodaily BTC - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-06-18	Jefe Caan – Bitcoin (BTC) Might Trade Sideways For Months But Correction Is Almost Over
2	2018-01-30	Jessica Whitley – Starbucks Is Open Into looking At CryptoCurrencies
3	2018-05-02	Robert Johnson – How To Outsmart A Bitcoin Thief Coin Talk Style
4	2019-04-14	Jefe Caan – Bitcoin (BTC) Bears Ready To Take Control After Months Of Indecision Sally Ho – Sally Ho's Technical Analysis 14 April 2019
5	2018-04-02	Jefe Caan – Is RSI The Best Indicator Of Trend Reversal For Bitcoin?
6	2018-04-05	Nathan Bentley – How A Law From 1816 Could Offer A Solution To Bitcoins Dirty Laundry
7	2018-11-25	Jefe Caan – Bitcoin (BTC) 'Capitulation' More Likely To Be Followed By Lawsuits Than Bull Runs
8	2019-10-13	Robert Johnson – Bitcoin Enters China Thanks to Binance & WeChat
9	2019-06-10	Sally Ho – Sally Ho's Technical Analysis 10 June 2019
10	2019-04-13	Adrian Barkley – How Croatia Is Pushing BTC Adoption
11	2019-08-25	Sally Ho – Sally Ho's Technical Analysis 25 August 2019
12	2018-08-22	Nathan Bentley – BitMEX Downtime See's BTC Rise 4% But This Is Bad News For Bitcoin ETFs
13	2019-03-24	Robert Johnson – Scam CIA Emails Want Your Bitcoin
14	2019-05-21	Jefe Caan – Bitcoin (BTC) Eyes A Fall To \$7000 After VanEck/SolidX ETF Decision Delay Robert Johnson – Teenage Crypto Millionaire Erik Finman Talks on 4 Big Issues Killing BTC
15	2018-06-24	Thomas Ramsay – Brian Kelly & Charlie Lee – Bitcoin Is Still Bullish
16	2019-01-05	Jefe Caan – Why Bitcoin (BTC) Is Not Likely To Fall Below \$3000
17	2018-10-26	Kyle Torpey – Smart Contracts Can Be a Short-Term Bandaid for Bitcoin's Price Volatility Issues
18	2019-01-03	Jefe Caan – Bitcoin (BTC): What Is The Volatility Index (VIX) Telling Us?
19	2018-12-23	Robert Johnson – Only 37% Of Bitcoin Addresses Are Economically Relevant
20	2019-05-15	Jefe Caan – Bitcoin (BTC) Rally Likely To End Badly As S&P 500 Points To Gloomy Outlook

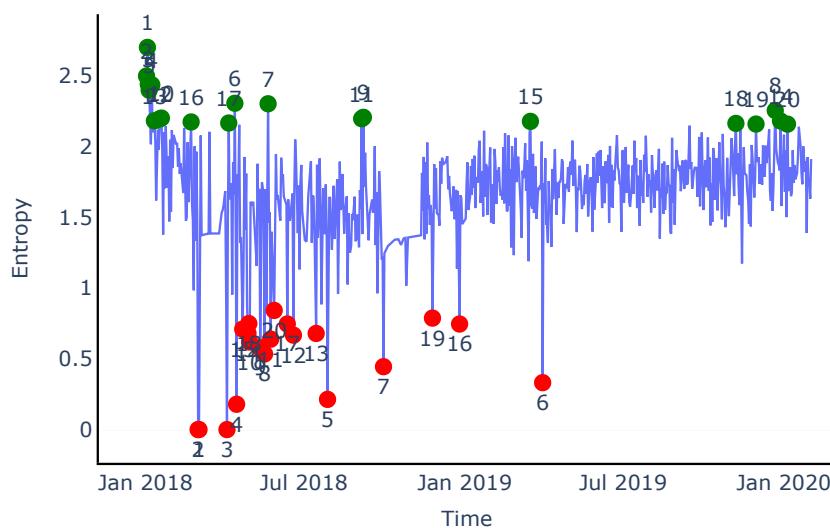
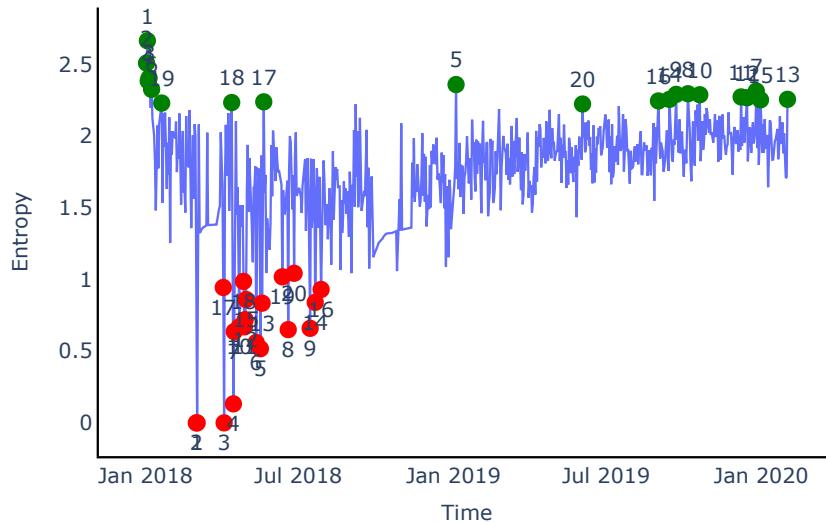
**Figure 12.** Top-20 articles that caused the strongest and lowest neutral sentiment - Cryptodaily BTC

Table 25. Cryptodaily BTC - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-03	Frankie Crowhurst – Is Bitcoin Affecting The Environment?
2	2018-01-02	Frankie Crowhurst – 5 Blockchain Predictions For 2018
3	2018-01-04	Frankie Crowhurst – 5 Cryptocurrencies You Need To Take Notice Of
4	2018-01-08	Frankie Crowhurst – Cryptocurrencies Break Through \$800Billion!
5	2018-01-05	Frankie Crowhurst – The End Of Bitcoin's Cheap Energy Feast
6	2018-04-13	Nathan Bentley – Experts Claim Next Bull Run Is Close Bitcoin Could Hit \$10000
7	2018-05-21	Jefe Caan – The Lower Bitcoin (BTC) Goes The Easier It Gets To Turn The Crypto Market Around'
8	2019-12-22	Jefe Caan – Ripple (XRP) May Outperform Bitcoin (BTC) And Ethereum (ETH) Again In 2018'
9	2018-09-07	Sally Ho – Sally Ho's Technical Analysis 22 December 2019 BTC ETH
10	2018-01-19	Jefe Caan – Bitcoin (BTC) Bull Flag Or Just Another Trap?
11	2018-09-05	Jefe Caan – Litecoin (LTC) Begins A New Cycle Against Bitcoin (BTC) But Still Risks A Fall Below \$50
12	2018-01-17	Rheace Jones – Bitcoin Accepted As A Church Offering
13	2018-01-11	Jefe Caan – Bitcoin (BTC) Faces Rejection At 21 Week EMA But Finds Strong Support At 21-Day EMA
14	2019-12-28	Rheace Jones – Private Jet Company Now Accepting Bitcoin And Ethereum
15	2019-03-17	Frankie Crowhurst – Jamie Dimon Regrets Calling Bitcoin A Fraud
16	2018-02-22	Jefe Caan – Why Bitcoin (BTC) Bulls Are Being Hopeful Again
17	2018-04-06	Sally Ho – Sally Ho's Technical Analysis 28 December 2019 BTC ETH
18	2019-11-07	Robert Johnson – Italian Facebook Users Notice New Payment Option On Platform
19	2019-11-30	Frankie Crowhurst – Japanese Exchange Gives Bitcoin Away Free
20	2020-01-05	Jefe Caan – Bitcoin (BTC) Might Complete An Adam And Eve Pattern Before Rising Again
		Frankie Crowhurst – Experts Predict That Bitcoin Will Sink Faster Than The Stocks This Year
		Sally Ho – 7 November 2019 ETH/BTC 4-hourly
		Jefe Caan – Bitcoin Risks Crash Below Key Structure
		Sally Ho – Sally Ho's Technical Analysis 30 November 2019
		Sally Ho – 5 January 2020 - BTC/ USD – 4-hourly
		Jefe Caan – Bitcoin (BTC) Faces Rejection At 50 Day EMA Risks Crippling Crash Below \$7k

Table 26. Cryptodaily BTC - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-03-03	Crypto IQ – Decentralized Ledger Systems: A New Age Of Record Keeping
2	2018-03-02	Frankie Crowhurst – Have Cryptocurrencies Become Too Big To Be Regulated?
3	2018-04-04	Nathan Bentley – Ethereum Moves Past Bitcoin And Takes Top Spot
4	2018-04-15	Lucy Haynes – 18 Percent Surge In Bitcoin Price Catches Everyone Off Guard
5	2018-07-28	Nathan Bentley – Bitcoin ETF Might Not Be Over Just Yet
6	2019-03-31	Adrian Barkley – Is The Right Time To Buy BTC Closer Than We Think?
7	2018-09-30	Adrian Barkley – Here's Why Paranoia Fuels Bitcoin
8	2018-05-17	Nathan Bentley – Optimism Probably Short Lived Bitcoin Heads Down Towards \$8000.00 Again
9	2018-05-12	Crypto IQ – Futures Launch Possible Reason For Bitcoin Decline
10	2018-04-30	Nathan Bentley – A Solid Weekend For Bitcoin As Value Looks To Rise Further
11	2018-05-24	Thomas Ramsay – US Authorities Suspicious That Bitcoin Price Manipulation Could Be Driving Markets Down
12	2018-06-19	Thomas Ramsay – John McAfee Promises \$500000 Bitcoin Price If Elected President
13	2018-07-15	Nathan Bentley – Top Bitcoin Scenarios Right NOW
14	2018-04-28	Crypto IQ – Crypto Price Analysis - What's Happening Post 2017 Tax Season?
15	2018-04-22	Frankie Crowhurst – Why 'Whales' Can Determine The Price Of Bitcoin
16	2018-12-26	Crypto Daily – Did You Receive Any Bitcoin This Christmas?
17	2018-06-12	Robert Johnson – What Will It Take To Get Bitcoin Back Up To \$10000?
18	2018-04-29	Crypto IQ – 17000000th Bitcoin To Be Mined Soon - What's The Relevance?
19	2018-11-25	Jefe Caan – Bitcoin (BTC) 'Capitulation' More Likely To Be Followed By Lawsuits Than Bull Runs
20	2018-05-28	Nathan Bentley – The Crypto Refresh May 28th

**Figure 13.** Top-20 articles that caused strongest and lowest sentiment - Cryptodaily BTC**Table 27.** Cryptodaily BTC - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-03	Frankie Crowhurst – Bitcoin Accounts Frozen By Australia Banks
2	2018-01-02	Frankie Crowhurst – 5 Blockchain Predictions For 2018
3	2018-01-05	Frankie Crowhurst – The End Of Bitcoin's Cheap Energy Feast
4	2018-01-04	Frankie Crowhurst – 5 Cryptocurrencies You Need To Take Notice Of
5	2019-01-04	Jefe Caan – S&P 500 Future Outlook Hints At Green Months For Bitcoin (BTC) Ahead
6	2018-01-08	Frankie Crowhurst – Cryptocurrencies Break Through \$800Billion!
7	2019-12-26	Sally Ho – Sally Ho's Technical Analysis 26 December 2019 BTC ETH
8	2019-10-06	Sally Ho – Sally Ho's Technical Analysis 6 October 2019
9	2019-09-22	Sally Ho – Sally Ho's Technical Analysis 22 September 2019
10	2019-10-20	Adrian Barkley – The Genesis Capital CEO On Why No One is Shorting Bitcoin
11	2019-12-08	Jefe Caan – Why Shorting Bitcoin (BTC) Is Not Worth It At This Point
12	2019-12-15	Sally Ho – 8 December 2019 - LTC / BTC- 4-hourly
13	2020-02-01	Sally Ho – Sally Ho's Technical Analysis 15 December 2019 BTC ETH
14	2019-09-14	Adrian Barkley – What You Should Know About Bitcoins Hash Rate
15	2019-12-31	Sally Ho – Sally Ho's Technical Analysis 1 February 2020 BTC ETH
16	2019-09-01	Jefe Caan – Robert Johnson – Here's Why Bitcoin Could Blow up in 2020 - Travis Kling
17	2018-05-21	Jefe Caan – Could Gold (XAU/USD) And Bitcoin (BTC) Have Topped At The Same Time?
18	2018-04-13	Sally Ho – Jefe Caan – Ripple (XRP) May Outperform Bitcoin (BTC) And Ethereum (ETH) Again In 2018
19	2018-01-20	Jefe Caan – The Lower Bitcoin (BTC) Goes The Easier It Gets To Turn The Crypto Market Around
20	2019-06-03	Frankie Crowhurst – \$1.2Billion Worth Of Cryptocurrencies Have Been Stolen By Hackers

Table 28. Cryptodaily BTC - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-03-03	Crypto IQ – Decentralized Ledger Systems: A New Age Of Record Keeping
2	2018-03-02	Frankie Crowhurst – Have Cryptocurrencies Become Too Big To Be Regulated?
3	2018-04-04	Nathan Bentley – Ethereum Moves Past Bitcoin And Takes Top Spot
4	2018-04-15	Lucy Haynes – 18 Percent Surge In Bitcoin Price Catches Everyone Off Guard
5	2018-05-17	Nathan Bentley – Optimism Probably Short Lived Bitcoin Heads Down Towards \$8000.00 Again
6	2018-05-12	Crypto IQ – Futures Launch Possible Reason For Bitcoin Decline
7	2018-04-16	Nathan Bentley – bitPico Carry Out Large Scale Attack On Bitcoin Network
8	2018-06-19	Robert Johnson – Binance CEO Talks About The Bitcoin Correction Point
9	2018-07-15	Nathan Bentley – Top Bitcoin Scenarios Right NOW
10	2018-04-22	Frankie Crowhurst – Why ‘Whales’ Can Determine The Price Of Bitcoin
11	2018-04-28	Crypto IQ – Crypto Price Analysis - What’s Happening Post 2017 Tax Season?
12	2018-04-29	Crypto IQ – 17000000th Bitcoin To Be Mined Soon - What’s The Relevance?
13	2018-05-19	Thomas Ramsay – Twitter CEO Wants Bitcoin To Take Over The Internet
14	2018-07-21	Robert Johnson – American Congressman Says Bitcoin Mining Should Be Made Illegal
15	2018-04-30	Nathan Bentley – A Solid Weekend For Bitcoin As Value Looks To Rise Further
16	2018-07-28	Nathan Bentley – Bitcoin ETF Might Not Be Over Just Yet
17	2018-04-03	Nathan Bentley – Bitcoin Approaches \$7500 Is A Recovery In Sight?
18	2018-04-27	Nathan Bentley – The Crypto Refresh April 27th
19	2018-06-12	Nathan Bentley – Bitcoin Runs Off Trust And Nothing More
20	2018-06-26	Nathan Bentley – ‘Crypto Virgins’ Are Driving The Price Of Bitcoin

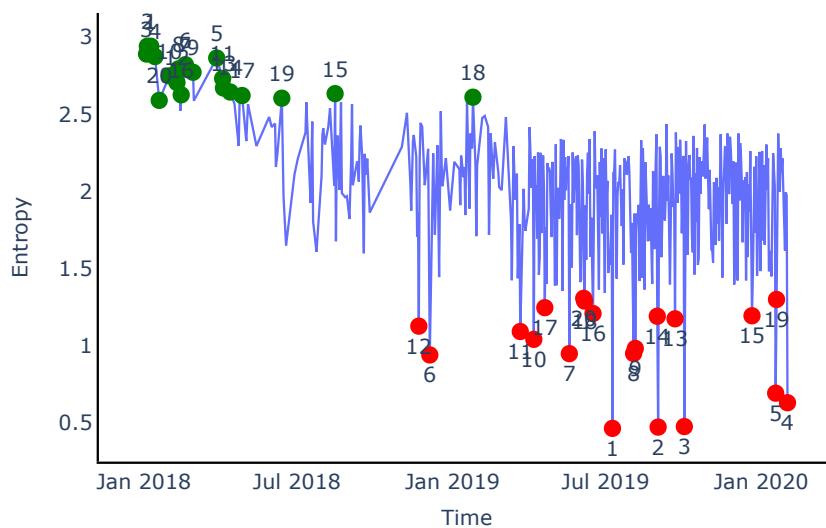
**Figure 14.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptodaily ETH

Table 29. Cryptodaily ETH - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-01-09	Denis Vinokourov – Anonymity used to come to the Premium - until now. ADAMANT is here folks!
2	2018-01-05	Denis Vinokourov – The clash of cultures
3	2018-01-04	Denis Vinokourov – From the Las Vegas strip to blockchain code. SP8DE ICO is coming...
4	2018-01-14	Frankie Crowhurst – Ethereum Doubles In Value
5	2018-03-28	Frankie Crowhurst – Analyst Believes Ethereum Will Rise Again
6	2018-02-19	Thomas Ramsay – When Will Crypto Hit \$1 Trillion?
7	2018-02-18	Thomas Ramsay – These 4 Cryptocurrencies Rose When Bitcoin And Ripple Fell
8	2018-02-11	Jessica Whitley – Ethereum's Blockchain Is Being Tailed In A Number Of Exciting Ways
9	2018-02-28	Thomas Ramsay – Cardano (ADA) Wants To Beat Bitcoin And Ethereum
10	2018-01-31	Simon Chester – Dan Larimer Keeps Predicting The Future
11	2018-04-04	Nathan Bentley – Ethereum Moves Past Bitcoin And Takes Top Spot
12	2018-02-09	Frankie Crowhurst – What's The Deal With Smart Contract? NEO v Ethereum v Bitcoin
13	2018-04-05	Jefe Caan – Ethereum Classic (ETC): The Forgotten Twin Brother Of Ethereum (ETH)
14	2018-04-13	Jefe Caan – Is Ethereum (ETH) In Big Trouble?
15	2018-08-15	Robert Johnson – Stop Unfollowing Ethereum Scam Bots Twitter Actually Wants You To Follow Them Instead
16	2018-02-14	Frankie Crowhurst – Why You Should Invest In Ethereum After The 2018 Crash
17	2018-04-27	Jefe Caan – Ethereum (ETH) Infighting Might Lead To Critical Hard Fork
18	2019-01-25	Jefe Caan – Ethereum (ETH) Consolidates Above Local Bottom Before Next Decisive Move
19	2018-06-13	Nathan Bentley – Ethereum Sinks To New Low As Hackers Steal \$20 Million Through Port 8584 Hack
20	2018-01-19	Frankie Crowhurst – Ethereum Blockchain Technology Will Revolutionise Digital Asset Value

Table 30. Cryptodaily ETH - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-07-09	Sally Ho – Sally Ho's Technical Analysis 9 July 2019
2	2019-09-01	Sally Ho – Sally Ho's Technical Analysis 1 September 2019
3	2019-10-02	Sally Ho – Sally Ho's Technical Analysis 2 October 2019
4	2020-02-01	Sally Ho – Sally Ho's Technical Analysis 1 February 2020 BTC ETH
5	2020-01-18	Sally Ho – Sally Ho's Technical Analysis 18 January 2020 BTC ETH
6	2018-12-05	Robert Johnson – The Potential Of Infura On Ethereum
7	2019-05-19	Sally Ho – Sally Ho's Technical Analysis 19 May 2019
8	2019-08-03	Sally Ho – Sally Ho's Technical Analysis 3 August 2019
9	2019-08-05	Sally Ho – Sally Ho's Technical Analysis 5 August 2019
10	2019-04-07	Sally Ho – Sally Ho's Technical Analysis 7th April 2019
11	2019-03-22	Robert Johnson – Why Does Buterin Care About The Price Of Ethereum?
12	2018-11-22	Adrian Barkley – Ethereum Founder Exploring Ground In Turkey
13	2019-09-21	Sally Ho – Sally Ho's Technical Analysis 21 September 2019
14	2019-08-31	Sally Ho – Sally Ho's Technical Analysis 31 August 2019
15	2019-12-21	Sally Ho – Sally Ho's Technical Analysis 21 December 2019 BTC ETH
16	2019-06-16	Sally Ho – Sally Ho's Technical Analysis 16 June 2019
17	2019-04-20	Sally Ho – Sally Ho's Technical Analysis 20 April 2019
18	2019-06-06	Sally Ho – Sally Ho's Technical Analysis 6 June 2019
19	2020-01-19	Sally Ho – Sally Ho's Technical Analysis 19 January 2020 BTC ETH
20	2019-06-05	Sally Ho – Sally Ho's Technical Analysis 5 June 2019

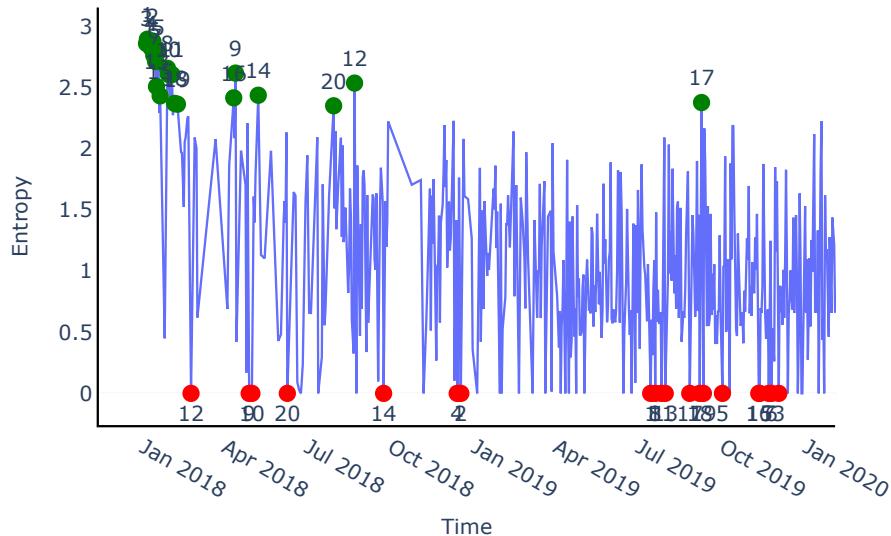


Table 32. Cryptodaily ETH - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-07-13	Sally Ho – Sally Ho's Technical Analysis 13 July 2019
2	2018-12-16	Robert Johnson – One Day the Law Might Protect Illegitimate Ethereum Transactions
3	2019-12-01	Sally Ho – Sally Ho's Technical Analysis 1 December 2019 BTC ETH
4	2018-12-12	Jefe Caan – Ethereum (ETH) Eyes A Sharp Decline To \$80 As Bulls Fail To Defend Price
5	2019-09-30	Sally Ho – Sally Ho's Technical Analysis 30 September 2019
6	2019-11-23	Sally Ho – Sally Ho's Technical Analysis 23 November 2019
7	2019-11-20	Jefe Caan – Ethereum (ETH) Risks Further Decline Within Descending Broadening Wedge
8	2019-07-18	Sally Ho – Sally Ho's Technical Analysis 18 July 2019
9	2018-04-27	Jefe Caan – Ethereum (ETH) Infighting Might Lead To Critical Hard Fork
10	2018-04-30	Jefe Caan – VeChain (VEN) Could Be The Ethereum Of Business
11	2019-07-25	Jefe Caan – Ethereum (ETH) Likely To Have Topped Out After Recent Bullish Move
12	2018-02-22	Frankie Crowhurst – 2018 Is A Big Year For EOS Could It Overtake Ethereum?
13	2019-07-29	Jefe Caan – Ethereum (ETH) Unlikely To Fall Below \$200 Anytime Soon
14	2018-09-22	Jefe Caan – Has Ethereum (ETH) Finally Lost Its Charm?
15	2019-11-10	Sally Ho – Sally Ho's Technical Analysis 10 November 2019
16	2019-11-09	Sally Ho – Sally Ho's Technical Analysis 9 November 2019
17	2019-08-25	Sally Ho – Sally Ho's Technical Analysis 25 August 2019
18	2019-09-05	Sally Ho – Sally Ho's Technical Analysis 5 September 2019
19	2019-09-09	Jefe Caan – Ethereum (ETH) Fails To See Organic Buying Interest Decline Expected Ahead
20	2018-06-08	Robert Johnson – Bug Found In Ethereum Software Parity

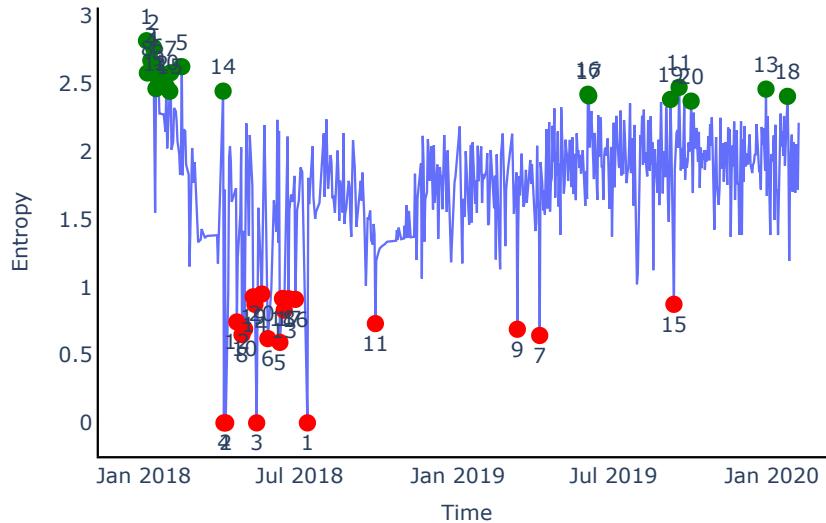


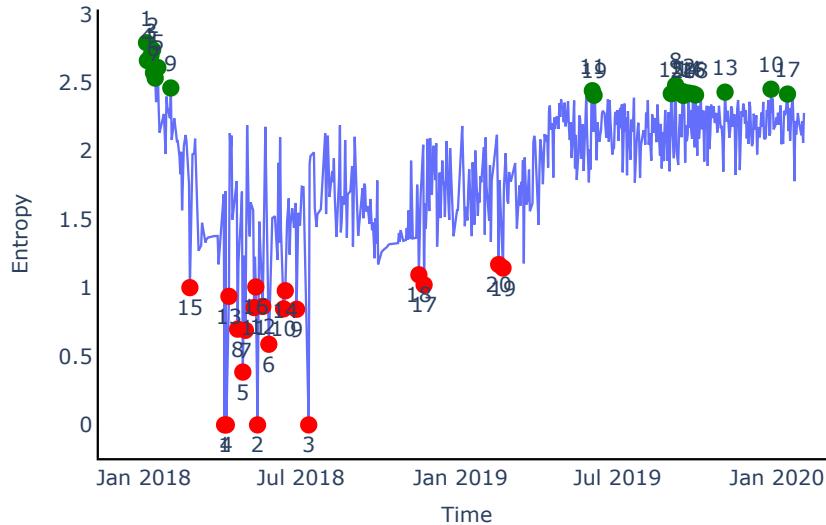
Figure 16. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptodaily ETH

Table 33. Cryptodaily ETH - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-04	Frankie Crowhurst – 5 Cryptocurrencies You Need To Take Notice Of
2	2018-01-12	Denis Vinokourov – EOS - the sleepy giant is finally waking up
3	2018-01-09	Denis Vinokourov – Anonymity used to come to the Premium - until now. ADAMANT is here folks!
4	2018-01-11	Frankie Crowhurst – Ethereum Outperforms Bitcoin!
5	2018-02-14	Frankie Crowhurst – Why You Should Invest In Ethereum After The 2018 Crash
6	2018-01-17	Rheace Jones – Private Jet Company Now Accepting Bitcoin And Ethereum
7	2018-02-01	Frankie Crowhurst – IOS Token Better Than Ethereum?
8	2018-01-05	Denis Vinokourov – The clash of cultures
9	2018-01-18	Frankie Crowhurst – Things That Are More Important Than The Ethereum Price Crash Rheace Jones – Find Out How Blockchain Could Change Energy Markets
10	2018-01-27	Frankie Crowhurst – 3 Blockchain Stars To Watch In 2018
11	2019-09-15	Sally Ho – Sally Ho's Technical Analysis 15 September 2019
12	2018-01-15	Rheace Jones – Bitcoin Vs Ethereum
13	2019-12-25	Sally Ho – Sally Ho's Technical Analysis 25 December 2019 BTC ETH
14	2018-04-03	Frankie Crowhurst – Why Ethereum Is Underperforming Its Rivals
15	2018-01-31	Simon Chester – Dan Larimer Keeps Predicting The Future
16	2019-06-01	Sally Ho – Sally Ho's Technical Analysis 1 June 2019
17	2019-06-02	Sally Ho – Sally Ho's Technical Analysis 2 June 2019
18	2020-01-19	Sally Ho – Sally Ho's Technical Analysis 19 January 2020 BTC ETH
19	2019-09-05	Sally Ho – Sally Ho's Technical Analysis 5 September 2019
20	2019-09-29	Sally Ho – Sally Ho's Technical Analysis 29 September 2019

Table 34. Cryptodaily ETH - bottom 20 articles for neutral sentiment

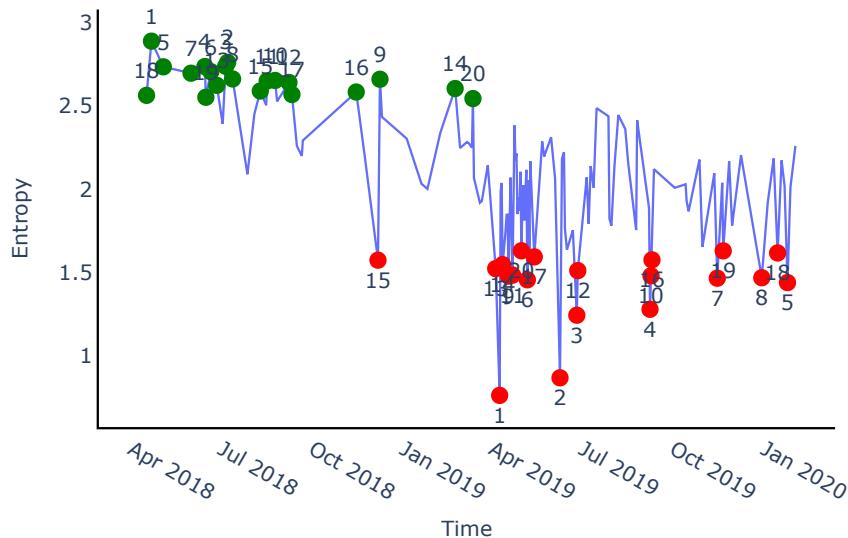
Rank	Date	Author - Article
1	2018-07-10	Robert Johnson – Latest Crypto Hack Sees \$13.5 Million Ethereum And PundiX Stolen
2	2018-04-06	Crypto IQ – Hard Cap Proposal By Buterin For Ethereum Not An April Fool's Joke
3	2018-05-12	Crypto IQ – Enterprise Ethereum Alliance Back In Action
4	2018-04-04	Nathan Bentley – Ethereum Moves Past Bitcoin And Takes Top Spot
5	2018-06-08	Thomas Ramsay – Ripple's Codius Could Crush Ethereum
6	2018-05-25	Thomas Ramsay – Market Climb Now In Full Effect Bitcoin Ethereum & Ripple All Shifting
7	2019-04-06	Jefe Caan – Ethereum (ETH) Shorts Decline To New All-Time Low Price Remains Overbought
8	2018-04-25	Nathan Bentley – The Ethereum Blockchain Is Inspiring Movements In China
9	2019-03-11	Sally Ho – Sally Ho's Technical Analysis ETH/USD - 11th March 2019
10	2018-04-28	Crypto IQ – Developers Think Ethereum Blockchain Fork Might Just Happen
11	2018-09-27	Crypto Daily – Crypto Daily Official YouTube Ethereum Giveaway - Here's What You Need To Know
12	2018-04-19	Nathan Bentley – Ethereum Has The Potential To Break \$600 Today!
13	2018-06-13	Nathan Bentley – Ethereum Sinks To New Low As Hackers Steal \$20 Million Through Port 8584 Hack
14	2018-05-10	Thomas Ramsay – Markets Break Away From Negativity Just Look At Ethereum Ripple And VeChain
15	2019-09-09	Jefe Caan – Ethereum (ETH) Fails To See Organic Buying Interest Decline Expected Ahead
16	2018-06-26	Nathan Bentley – Bitcoin Ethereum & Ripple Still Up As Market Balance Continues
17	2018-06-18	Robert Johnson – Bitcoin Ethereum And Ripple Just Can't Seem To Break Away From Bears Grip
18	2018-06-11	Nathan Bentley – Emergency Market Review
19	2018-05-08	Thomas Ramsay – Bitcoin & Ethereum Continue To Soar Ripple Struggles
20	2018-05-18	Nathan Bentley – Last Time Ethereum Did This It Shot Up \$500.00

**Figure 17.** Top-20 articles that caused strongest and lowest sentiment - Cryptodaily ETH**Table 35.** Cryptodaily ETH - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-04	Frankie Crowhurst – 5 Cryptocurrencies You Need To Take Notice Of
2	2018-01-11	Frankie Crowhurst – Ethereum Outperforms Bitcoin!
3	2018-01-09	Denis Vinokourov – Anonymity used to come to the Premium - until now. ADAMANT is here folks!
4	2018-01-05	Denis Vinokourov – The clash of cultures
5	2018-01-17	Rheace Jones – Private Jet Company Now Accepting Bitcoin And Ethereum
6	2018-01-12	Denis Vinokourov – EOS - the sleepy giant is finally waking up
7	2018-01-14	Frankie Crowhurst – Ethereum Doubles In Value
8	2019-09-06	Sally Ho – Sally Ho's Technical Analysis 6 September 2019
9	2018-02-01	Frankie Crowhurst – IOS Token Better Than Ethereum?
10	2019-12-25	Sally Ho – Sally Ho's Technical Analysis 25 December 2019 BTC ETH
11	2019-06-02	Sally Ho – Sally Ho's Technical Analysis 2 June 2019
12	2019-09-14	Sally Ho – Sally Ho's Technical Analysis 14 September 2019
13	2019-11-02	Sally Ho – Sally Ho's Technical Analysis 2 November 2019
14	2019-09-21	Sally Ho – Sally Ho's Technical Analysis 21 September 2019
15	2019-09-01	Sally Ho – Sally Ho's Technical Analysis 1 September 2019
16	2019-09-26	Sally Ho – Sally Ho's Technical Analysis 26 September 2019
17	2020-01-13	Sally Ho – Sally Ho's Technical Analysis 13 January 2020 BTC ETH
18	2019-09-29	Sally Ho – Sally Ho's Technical Analysis 29 September 2019
19	2019-06-04	Sally Ho – Sally Ho's Technical Analysis 4 June 2019
20	2019-09-15	Sally Ho – Sally Ho's Technical Analysis 15 September 2019

Table 36. Cryptodaily ETH - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-04-04	Nathan Bentley – Ethereum Moves Past Bitcoin And Takes Top Spot
2	2018-05-12	Crypto IQ – Enterprise Ethereum Alliance Back In Action
3	2018-07-10	Robert Johnson – Latest Crypto Hack Sees \$13.5 Million Ethereum And PundiX Stolen
4	2018-04-06	Crypto IQ – Hard Cap Proposal By Buterin For Ethereum Not An April Fool's Joke
5	2018-04-25	Nathan Bentley – The Ethereum Blockchain Is Inspiring Movements In China
6	2018-05-25	Thomas Ramsay – Market Climb Now In Full Effect Bitcoin Ethereum & Ripple All Shifting
7	2018-04-28	Crypto IQ – Developers Think Ethereum Blockchain Fork Might Just Happen
8	2018-04-19	Nathan Bentley – Ethereum Has The Potential To Break \$600 Today!
9	2018-06-26	Nathan Bentley – Bitcoin Ethereum & Ripple Still Up As Market Balance Continues
10	2018-06-11	Nathan Bentley – Emergency Market Review
11	2018-05-08	Thomas Ramsay – Bitcoin & Ethereum Continue To Soar Ripple Struggles
12	2018-05-18	Nathan Bentley – Last Time Ethereum Did This It Shot Up \$500.00
13	2018-04-09	Nathan Bentley – Markets Looking Good Ahead Of New Week
14	2018-06-13	Nathan Bentley – Ethereum Sinks To New Low As Hackers Steal \$20 Million Through Port 8584 Hack
15	2018-02-23	Frankie Crowhurst – Why You Might Soon Be Able To Trade Bitcoin And Ethereum With No Fees
16	2018-05-10	Nathan Bentley – Ethereum Leads Market Direction Change Are Things Going To Start Looking Up?
17	2018-11-20	Robert Johnson – How Ethereum's Beacon Chain Works
18	2018-11-14	Robert Johnson – Ethereums New Protocol Shows Great Promise
19	2019-02-19	Adrian Barkley – TRON Finally Beats Ethereum For The dApp Gold Medal
20	2019-02-14	Robert Johnson – Don't Miss The Top Ethereum Debit Cards

**Figure 18.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptodaily LTC**Table 37.** Cryptodaily LTC - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-04-21	Frankie Crowhurst – Is Litecoin One To Watch? Experts Price Predictions
2	2018-07-07	Robert Johnson – The Decline Of Litecoin Through 2018 What Does Litecoin Need To Reach The Top?
3	2018-07-05	Nathan Bentley – Market Update: Prices Up But Bitcoin Cash And Litecoin Lag Behind
4	2018-06-14	Jefe Caan – Litecoin (LTC) All Set To Break Past \$100 Mark
5	2018-05-03	Jefe Caan – Litecoin (LTC) Price Might Drop Below \$30 Before 2020
6	2018-06-20	Jefe Caan – Litecoin (LTC) Consolidates Above \$90 Eyes A Break Past \$100 In The Days Ahead
7	2018-05-31	Jefe Caan – Litecoin (LTC) Downtrend Continues Despite Potential Market Reversal
8	2018-07-12	Jefe Caan – Litecoin (LTC) Chart Best Explains Both Bullish And Bearish Scenarios For Cryptocurrencies
9	2018-12-08	Mark Nezvinsky – Exciting News For TRON TRX XRP & Litecoin
10	2018-08-24	Robert Johnson – September Presents A Great Opportunity For Litecoin To Relaunch Litepay
11	2018-08-16	Adrian Barkley – BTC And LTC Find Balance XLM And MIOTA Struggling To Maintain
12	2018-09-07	Jefe Caan – Litecoin (LTC) Begins A New Cycle Against Bitcoin (BTC) But Still Risks A Fall Below \$50
13	2018-06-26	Jefe Caan – Litecoin (LTC) Continues To Show Weakness Pullback To Lower Levels Likely
14	2019-02-22	Adrian Barkley – Where Is XRP? Ask Coinbase Community
15	2018-08-09	Jefe Caan – Litecoin (LTC) Is No Longer The Cheapest Coin On Coinbase
16	2018-11-14	Adrian Barkley – Scammer Sentenced Over \$1 Million LTC Scheme
17	2018-09-10	Mark Nezvinsky – What's The Point In #PayWithLitecoin
18	2018-04-16	Jefe Caan – Litecoin (LTC) And Bitcoin Cash (BCH) Could Lose Their Positions Before 2019
19	2018-06-15	Robert Johnson – Paxos To Add Ethereum Litecoin Bitcoin Cash And Stellar
20	2019-03-12	Jefe Caan – Litecoin (LTC) Primed For Double Digit Decline In The Weeks Ahead

Table 38. Cryptodaily LTC - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-04-08	Sally Ho – Sally Ho's Technical Analysis 8th April
2	2019-06-08	Jefe Caan – Litecoin (LTC) Might Rally Hard Short Term If Price Breaks Past \$120
3	2019-06-25	Siebe Slagter – Litecoin's (LTC) 4.3% Plunge Knocks CD 21 Leaders Index Lower to 54.72
4	2019-09-07	Sally Ho – Sally Ho's Technical Analysis 7 September 2019
5	2020-01-24	Andreas Waechter – Dev Says Litecoin Might Soft Fork When Bitcoin (BTC) Does
6	2019-05-06	Sally Ho – Sally Ho's Technical Analysis 6 May 2019
7	2019-11-14	Sally Ho – Sally Ho's Technical Analysis 14 November 2019
8	2019-12-29	Sally Ho – Sally Ho's Technical Analysis 29 December 2019 LTC BCH
9	2019-04-17	Sally Ho – Sally Ho's Technical Analysis 17 April 2019
10	2019-09-08	Sally Ho – Sally Ho's Technical Analysis 8 September 2019
11	2019-04-21	Sally Ho – Sally Ho's Technical Analysis 21 April 2019
12	2019-06-26	Sally Ho – Sally Ho's Technical Analysis 26 June 2019
13	2019-04-04	Sally Ho – Sally Ho's Technical Analysis 4th April 2019
14	2019-04-11	Sally Ho – Sally Ho's Technical Analysis 11th April
15	2018-12-06	Robert Johnson – Crypto Whale Now Owns 15% Of Litecoin
16	2019-09-09	Sally Ho – Sally Ho's Technical Analysis 9 September 2019
17	2019-05-13	Jefe Caan – Litecoin (LTC) Likely To Fall Back To \$70 As Price Forms A Double Top
18	2020-01-14	Sally Ho – Sally Ho's Technical Analysis 14 January 2020 LTC BCH
19	2019-11-20	Sally Ho – Sally Ho's Technical Analysis 20 November 2019
20	2019-04-30	Sally Ho – Sally Ho's Technical Analysis 30 April 2019

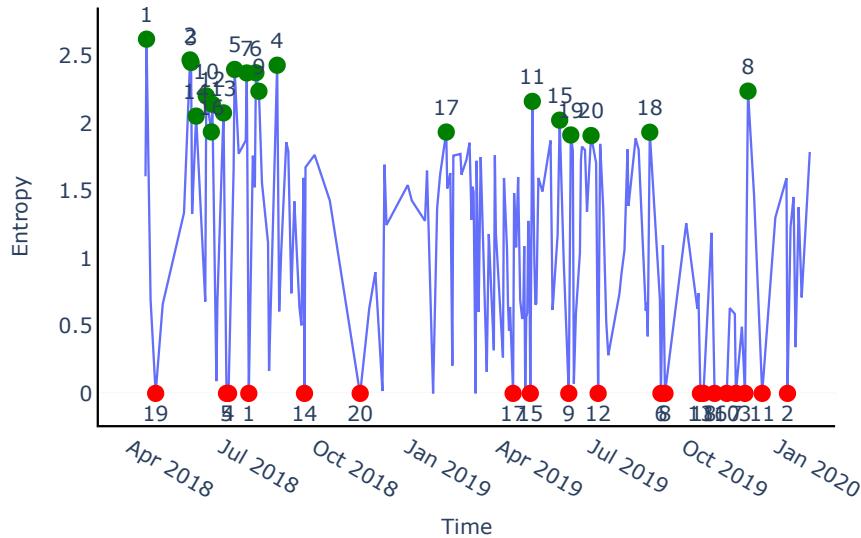


Figure 19. Top-20 articles that caused strongest and lowest positive sentiment - Cryptodaily LTC

Table 39. Cryptodaily LTC - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-04-17	Nathan Bentley – Litecoin Could Soar With Brand New Exchange Listing
2	2018-05-30	Robert Johnson – Charlie Lee On What Makes Litecoin So Secure
3	2018-05-31	Jefe Caan – Litecoin (LTC) Downtrend Continues Despite Potential Market Reversal
4	2018-08-24	Robert Johnson – September Presents A Great Opportunity For Litecoin To Relaunch Litepay
5	2018-07-13	Adrian Barkley – You're A Small Business Owner Should You Accept Litecoin?
6	2018-08-03	Robert Johnson – Queensland Government To Support Payments In BTC LTC ETH DASH And XEM
7	2018-07-25	Nathan Bentley – Market Update: BTC EOS And XLM On Top Of Their Games As LTC Sinks
8	2019-12-02	Robert Johnson – Banking Litecoin: Charlie Lee Talks On Banks And Cryptocurrency
9	2018-08-06	Robert Johnson – New Coinbase Plugin Will Help Bitcoin Ethereum Litecoin & Bitcoin Cash Reach Millions
10	2018-06-15	Robert Johnson – Paxos To Add Ethereum Litecoin Bitcoin Cash And Stellar
11	2019-05-03	Sally Ho – Sally Ho's Technical Analysis 3 May 2019
12	2018-06-21	Mark Nezvinsky – Weekly Roundup: Exciting DOGE XRP & LTC News
13	2018-07-02	Thomas Ramsay – Litecoin Futures Could Hit \$150 Million Volume In Three Months On Tomorrow's New Exchange Listing
14	2018-06-05	Jefe Caan – Litecoin (LTC) Bear Trend Could Be Just Getting Started
15	2019-05-30	Thomas Ramsay – What Will The 2018 Litecoin Summit Bring?
16	2018-06-20	Jefe Caan – Litecoin (LTC) Fails To Break Key Resistance During Recent Altcoin Rally
17	2019-02-07	Jefe Caan – Litecoin (LTC) Consolidates Above \$90 Eyes A Break Past \$100 In The Days Ahead
18	2019-08-27	Jefe Caan – Why Litecoin (LTC) Risks A Fall To \$25 Before It Resumes A Rally Towards \$100
19	2019-06-10	Adrian Barkley – Leading Analyst Predicts Litecoin To Zoom 100% Past Bitcoin
20	2019-06-30	Jefe Caan – Litecoin (LTC) Storms Past \$120 Further Upside Likely

Table 40. Cryptodaily LTC - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-07-27	Robert Johnson – Market Update - A Down Swing For BTC XLM And LTC Whilst VEN Hits The Moon
2	2020-01-10	Jefe Caan – Litecoin (LTC) Risks Another Brutal Downtrend If Bitcoin (BTC) Nosedives
3	2019-11-29	Sally Ho – 29 November 2019 - LTC/GBP - 15-minute
4	2018-07-07	Robert Johnson – The Decline Of Litecoin Through 2018 What Does Litecoin Need To Reach The Top?
5	2018-07-05	Nathan Bentley – Market Update: Prices Up But Bitcoin Cash And Litecoin Lag Behind
6	2019-09-07	Sally Ho – Sally Ho's Technical Analysis 7 September 2019
7	2019-11-20	Sally Ho – Sally Ho's Technical Analysis 20 November 2019
8	2019-09-11	Jefe Caan – Could Litecoin (LTC) See Another Rally Towards \$100?
9	2019-06-08	Jefe Caan – Litecoin (LTC) Might Rally Hard Short Term If Price Breaks Past \$120
10	2019-11-11	Adrian Barkley – Did You Miss These Important Ethereum Classic And Litecoin Updates?
11	2019-12-16	Robert Johnson – Augusts Dust Attack Still Looms On Litecoin Network
12	2019-07-07	Sally Ho – Sally Ho's Technical Analysis 7 July 2019
13	2019-10-16	Robert Johnson – Charlie Lee Comforts Community on Bankruptcy Claims for Litecoin
14	2018-09-20	Robert Johnson – Charlie Lee Uncovers The Truth About Litecoin
15	2019-05-01	Sally Ho – Sally Ho's Technical Analysis 1 May 2019
16	2019-10-30	Adrian Barkley – With The MimbleWimble Integration Where Does This Leave Litecoin?
17	2019-04-14	Sally Ho – Sally Ho's Technical Analysis 14 April 2019
18	2019-10-19	Robert Johnson – Litecoin Turns 8 Is it Really Just a Silver Bitcoin?
19	2018-04-26	Robert Johnson – Bitcoin Cash Turns It's Crosshairs On Litecoin
20	2018-11-14	Adrian Barkley – Scammer Sentenced Over \$1 Million LTC Scheme

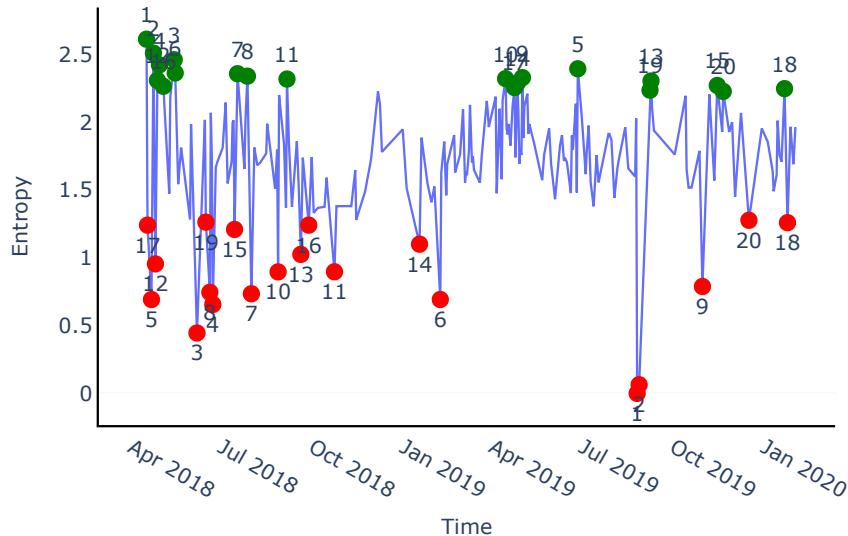


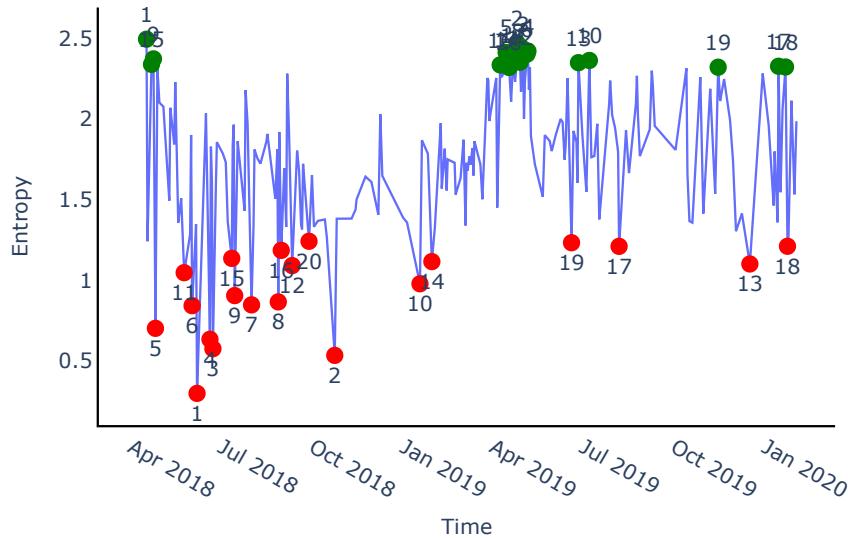
Figure 20. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptodaily LTC

Table 41. Cryptodaily LTC - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-04-16	Jefe Caan – Litecoin (LTC) And Bitcoin Cash (BCH) Could Lose Their Positions Before 2019
2	2018-04-23	Nathan Bentley – Litecoin Hits \$150 As Markets Fall
3	2018-05-14	Nathan Bentley – Zcash Bitcoin Cash & Litecoin To Receive Gemini Listing
4	2018-04-29	Frankie Crowhurst – Litecoin Could Take an Upswing Soon
5	2019-06-26	Sally Ho – Sally Ho's Technical Analysis 26 June 2019
6	2018-05-15	Robert Johnson – Litecoin Back Up Towards \$150.00 As Charlie Lee Discloses Information About His "Personal" Life
7	2018-07-17	Robert Johnson – Litecoin (LTC) Is Starting An Uptrend With Its Latest Price
8	2018-07-27	Robert Johnson – Market Update - A Down Swing For BTC XLM And LTC Whilst VEN Hits The Moon
9	2019-05-01	Sally Ho – Sally Ho's Technical Analysis 1 May 2019
10	2019-04-14	Sally Ho – Sally Ho's Technical Analysis 14 April 2019
11	2018-09-05	Adrian Barkley – Charlie Lee Is A Huge Fan Of This Lightning Network
12	2018-04-27	Nathan Bentley – What Does This Tweet From The Litecoin Foundation Mean?
13	2019-09-08	Sally Ho – Sally Ho's Technical Analysis 8 September 2019
14	2019-04-26	Sally Ho – Sally Ho's Technical Analysis 26 April 2019
15	2019-11-14	Sally Ho – Sally Ho's Technical Analysis 14 November 2019
16	2018-05-03	Robert Johnson – Ethereum and Litecoin to Be Added to Reddit as Bitcoin Payments Likely to Return Too
		Jefe Caan – Litecoin (LTC) Price Might Drop Below \$30 Before 2020
17	2019-04-23	Sally Ho – Sally Ho's Technical Analysis 23 April 2019
		Jefe Caan – Litecoin (LTC): Descending Triangle Hints At Strong Possibility Of Sell-Off
18	2020-01-21	Sally Ho – Sally Ho's Technical Analysis 21 January 2020 LTC BCH
19	2019-09-07	Sally Ho – Sally Ho's Technical Analysis 7 September 2019
20	2019-11-20	Sally Ho – Sally Ho's Technical Analysis 20 November 2019

Table 42. Cryptodaily LTC - bottom 20 articles for neutral sentiment

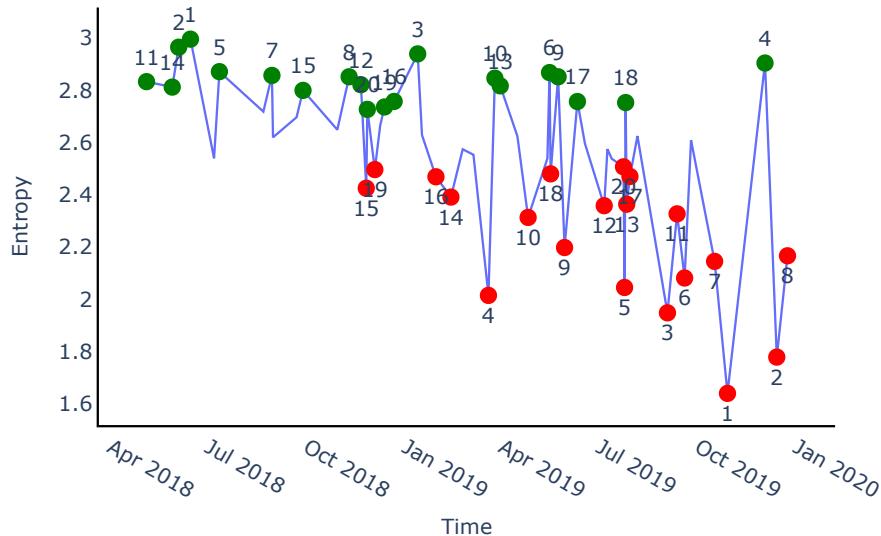
Rank	Date	Author - Article
1	2019-08-25	Jefe Caan – Litecoin (LTC) Likely To Decline Further But Significant Upside Might Soon Follow
2	2019-08-27	Adrian Barkley – Leading Analyst Predicts Litecoin To Zoom 100% Past Bitcoin
3	2018-06-06	Thomas Ramsay – Is Something Looming That Could See Litecoin Reach \$200?
4	2018-06-22	Robert Johnson – Heavy Downward Momentum Set To Project Markets Through The Weekend Bitcoin Ripple And Litecoin Fall
5	2018-04-21	Frankie Crowhurst – Is Litecoin One To Watch? Experts Price Predictions
6	2019-02-07	Jefe Caan – Why Litecoin (LTC) Risks A Fall To \$25 Before It Resumes A Rally Towards \$100
7	2018-07-31	Adrian Barkley – New HTC Exodus To Be Advised By Litecoin's Charlie Lee
8	2018-06-19	Robert Johnson – Two Reasons Why Litecoin Could Breakout Soon
9	2019-10-30	Adrian Barkley – With The MimbleWimble Integration Where Does This Leave Litecoin?
10	2018-08-27	Robert Johnson – A Brief History Of Litecoin
11	2018-10-23	Mark Nezvisky – Litecoin Is Looking To Take The Top Spot From Bitcoin
12	2018-04-25	Thomas Ramsay – Three Litecoin Applications That Could Make You Rich
13	2018-09-19	Adrian Barkley – How Litecoin Will Transform The Fast Food Industry
14	2019-01-17	Robert Johnson – Litecoin Fights Its Way To Mainstream Sport
15	2018-07-14	Nathan Bentley – Litecoin Network's Abra Now Supports Visa & Mastercard Payments
16	2018-09-27	Jefe Caan – Litecoin (LTC) Finally Forms A Strong Bottom Prepares For Trend Reversal
17	2018-04-17	Nathan Bentley – Litecoin Could Soar With Brand New Exchange Listing
18	2020-01-24	Andreas Waechter – Dev Says Litecoin Might Soft Fork When Bitcoin (BTC) Does
19	2018-06-15	Robert Johnson – Paxos To Add Ethereum Litecoin Bitcoin Cash And Stellar
20	2019-12-16	Robert Johnson – Augusts Dust Attack Still Looms On Litecoin Network

**Figure 21.** Top-20 articles that caused strongest and lowest sentiment - Cryptodaily LTC**Table 43.** Cryptodaily LTC - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-04-16	Nathan Bentley – Can Litecoin Stay Above \$120? Price Prediction
2	2019-04-25	Jefe Caan – Litecoin (LTC) And Bitcoin Cash (BCH) Could Lose Their Positions Before 2019
3	2019-05-01	Sally Ho – Sally Ho's Technical Analysis 25 April 2019
4	2019-05-06	Sally Ho – Sally Ho's Technical Analysis 1 May 2019
5	2019-04-14	Sally Ho – Sally Ho's Technical Analysis 6 May 2019
6	2019-05-05	Sally Ho – Sally Ho's Technical Analysis 14 April 2019
7	2019-04-27	Sally Ho – Sally Ho's Technical Analysis 5 May 2019
8	2019-04-26	Sally Ho – Sally Ho's Technical Analysis 27 April 2019
9	2018-04-23	Nathan Bentley – Litecoin Hits \$150 As Markets Fall
10	2019-07-07	Sally Ho – Sally Ho's Technical Analysis 7 July 2019
11	2019-04-21	Sally Ho – Sally Ho's Technical Analysis 21 April 2019
12	2019-04-28	Sally Ho – Sally Ho's Technical Analysis 28 April 2019
13	2019-06-26	Sally Ho – Sally Ho's Technical Analysis 26 June 2019
14	2019-04-15	Sally Ho – Sally Ho's Technical Analysis 15th April 2019
15	2018-04-21	Frankie Crowhurst – Is Litecoin One To Watch? Experts Price Predictions
16	2019-04-08	Sally Ho – Sally Ho's Technical Analysis 8th April
17	2020-01-14	Sally Ho – Sally Ho's Technical Analysis 14 January 2020 LTC BCH
18	2020-01-21	Sally Ho – Sally Ho's Technical Analysis 21 January 2020 LTC BCH
19	2019-11-14	Sally Ho – Sally Ho's Technical Analysis 14 November 2019
20	2019-04-17	Sally Ho – Sally Ho's Technical Analysis 17 April 2019

Table 44. Cryptodaily LTC - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-06-06	Thomas Ramsay – Is Something Looming That Could See Litecoin Reach \$200?
2	2018-10-23	Mark Nezvinsky – Litecoin Is Looking To Take The Top Spot From Bitcoin
3	2018-06-22	Robert Johnson – Heavy Downward Momentum Set To Project Markets Through The Weekend Bitcoin Ripple And Litecoin Fall
4	2018-06-19	Robert Johnson – Two Reasons Why Litecoin Could Breakout Soon
5	2018-04-25	Thomas Ramsay – Three Litecoin Applications That Could Make You Rich
6	2018-06-01	Robert Johnson – Anything Verge Can Do Litecoin Can Do Better
7	2018-07-31	Adrian Barkley – New HTC Exodus To Be Advised By Litecoin's Charlie Lee
8	2018-08-27	Robert Johnson – A Brief History Of Litecoin
9	2018-07-14	Nathan Bentley – Litecoin Network's Abra Now Supports Visa & Mastercard Payments
10	2019-01-17	Robert Johnson – Litecoin Fights Its Way To Mainstream Sport
11	2018-05-24	Robert Johnson – Pay With Litecoin Just Acquired 130000 New Companies
12	2018-09-10	Mark Nezvinsky – What's The Point In #PayWithLitecoin
13	2019-12-16	Robert Johnson – Augusts Dust Attack Still Looms On Litecoin Network
14	2019-01-29	Adrian Barkley – Confidential Transactions To Come To Litecoin This Year
15	2018-07-11	Nathan Bentley – Litecoin Price Up With News Of New Acquisition
16	2018-08-30	Adrian Barkley – BTC ETH And LTC Now Live On Yahoo Finance
17	2019-08-06	Robert Johnson – Litecoin Miners Left Out Of Pocket
18	2020-01-23	Diane Lockhart – New Privacy Features Expected On Litecoin (LTC)
19	2019-06-19	Adrian Barkley – New Debit Card Launching From Litecoin
20	2018-09-27	Jefe Caan – Litecoin (LTC) Finally Forms A Strong Bottom Prepares For Trend Reversal

**Figure 22.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptodaily TRX**Table 45.** Cryptodaily TRX - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-06-14	Jefe Caan – Cardano (ADA)'s Ouroboros Algorithm Might Be A Better Deal Than EOS (EOS) And TRON (TRX) Combined
2	2018-06-03	Nathan Bentley – The Crypto Refresh 2nd June
3	2019-01-12	Mark Nezvinsky – TRX Starts 2019 Off With A Bang As BTC & ETC Fall Victim To New Year
4	2019-12-02	Adrian Barkley – Poloniex Tell Users 'To Buy TRON' In Uncovered Tweet
5	2018-07-11	Nathan Bentley – Market Update - BTC XLM TRX XMR Down Once More
6	2019-05-15	Mark Nezvinsky – TRON: Is it Truly Decentralised? (2019)
7	2018-08-29	Robert Johnson – Premined Coins Like XRP TRX XLM And NEO Are Causing Problems For Index Funds
8	2018-11-09	Robert Johnson – TRON Gets A New Listing & Trading Pairs
9	2019-05-23	Adrian Barkley – Claims that Former TRON CTO Was Sacked for Bribery & Theft Surface
10	2019-03-25	Robert Johnson – Is Justin Sun Buying His Twitter Followers?
11	2018-05-04	Thomas Ramsay – Crypto Daily The Crypto Refresh
12	2018-11-20	Adrian Barkley – Zcash & TRON Show Promise For Future Despite Market Crash
13	2019-03-30	Mark Nezvinsky – WhatsApp To Adopt BTC? Plus Exciting News From TRX & XRP
14	2018-05-28	Nathan Bentley – The Crypto Refresh May 28th
15	2018-09-27	Nathan Bentley – Could TRON TRX Skyrocket In The Coming Weeks?
16	2018-12-21	Mark Nezvinsky – Don't Miss the Next TRON Revolution
17	2019-06-10	Laurie Dunn – DApps On The Ethereum Eos And Tron Blockchains Will Disrupt An Online Gambling Sector Worth Billions
18	2019-07-25	Robert Johnson – Justin Sun Addresses Allegations In A Recently Deleted Apology Post
19	2018-12-12	Robert Johnson – TRX Network Sees New Decentralised Exchange Go Live
20	2018-11-26	Adrian Barkley – Why TRX Should Be Considered By Bakkt

Table 46. Cryptodaily TRX - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-10-28	Robert Johnson – Justin Sun Teases Partnership with 'Mega-Corporation'
2	2019-12-13	Adrian Barkley – Weibo Kick Justin Sun off Platform for Violating Community Provisions
3	2019-09-02	Robert Johnson – TRON CEO Called Out By Popular Analyst Over Buying Twitter Followers
4	2019-03-19	Robert Johnson – TRON's Past Indicates It's Going The Right Way For Greater Success
5	2019-07-24	Adrian Barkley – Following Buffett Lunch Cancellation This Chinese Report Indicates TRON CEO Isn't Able To Leave China
6	2019-09-18	Robert Johnson – Justin Sun Donating More than \$1 Million For UBI Program By US Presidential Hopeful
7	2019-10-16	Robert Johnson – TRON's Favourite Investor Warren Buffett Makes Confident Bet on Bank of America
8	2019-12-23	Adrian Barkley – TRON Trademark Hits Roadblock With Disney Situation
9	2019-05-29	Adrian Barkley – TRON Continues To Show It's One Of The Best
10	2019-04-25	Robert Johnson – TRON to Partner with Liverpool FC?
11	2019-09-11	Robert Johnson – Trump Is Still Ignoring Justin Sun Over Warren Buffett Lunch Invite
12	2019-07-05	Robert Johnson – Ponzi Scheme Related To TRON Leaves Investors Pointing The Finger At Justin Sun
13	2019-07-26	Adrian Barkley – Justin Sun Appears At Influencer Party In San-Francisco Despite Warren Buffett Lunch Cancellation
14	2019-02-12	Adrian Barkley – TRON's Justin Sun Offers QuadrigaCX Victim Job After Losing Life Savings
15	2018-11-25	Mark Nezvinsky – Ouch What A Week! Still Good News For XLM ETC And TRX
16	2019-01-29	Robert Johnson – Did Weiss Ratings Just Apologise To TRON?
17	2019-07-29	Adrian Barkley – BitTorrent Founder Raises Yet ANOTHER Accusation Against Justin Sun
18	2019-05-16	Robert Johnson – Justin Sun Slightly Bitter Over TRON CTO Leaving Project
19	2018-12-03	Robert Johnson – TRON & ETH Battle It Out On Twitter
20	2019-07-23	Robert Johnson – TRX CEO Accused Of Illegal Fundraising Via TRON

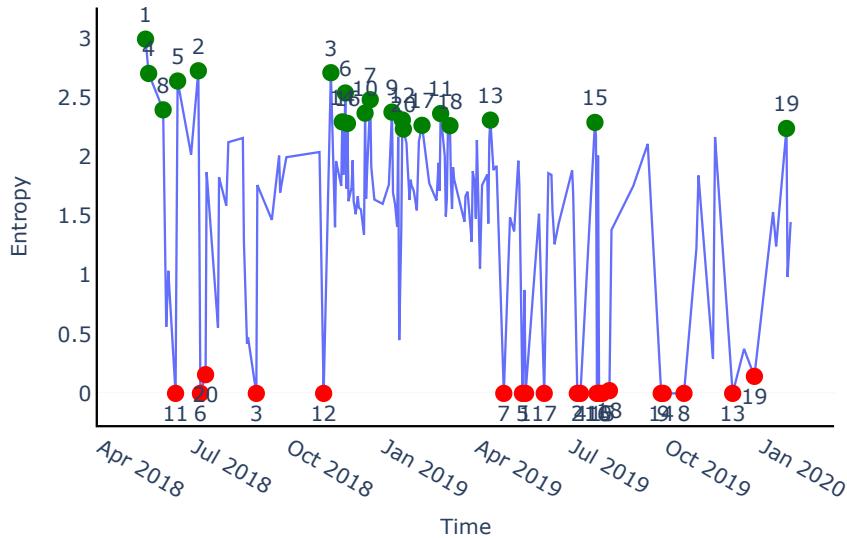


Figure 23. Top-20 articles that caused strongest and lowest positive sentiment - Cryptodaily TRX

Table 47. Cryptodaily TRX - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-05-14	Robert Johnson - Will A TRON Coinbase Listing See TRX To The Moon?
2	2018-07-04	Adrian Barkley - Google Trends Doesn't Actually Show An Increase In The Popularity Of XRP Or TRX
3	2018-11-09	Robert Johnson - TRON Gets A New Listing & Trading Pairs
4	2018-05-17	Jefe Caan - Cardano (ADA) Could Be Next On Coinbase Along With EOS (EOS) And Tron (TRX)
5	2018-06-14	Jefe Caan - Cardano (ADA)'s Ouroboros Algorithm Might Be A Better Deal Than EOS (EOS) And TRON (TRX) Combined
6	2018-11-23	Adrian Barkley - TRX Is Being Handed Out By Huobi'
7	2018-12-17	Adrian Barkley - TRON Reaches New Transaction Milestone'
8	2018-05-31	Nathan Bentley - Keen Eye For Bugs? Here's How You Could Make \$100K On The TRON MainNet
9	2019-01-07	Adrian Barkley - TRON Designs Token For BitTorrent
10	2018-12-12	Robert Johnson - TRX Network Sees New Decentralised Exchange Go Live
11	2019-02-23	Mark Nezvinsky - JPM Coin BCH & TRX: Where Do We Go From Here?
12	2019-01-17	Adrian Barkley - Why TRX ETH & XRP Could Each See A Bull Run In 2019
13	2019-04-12	Mark Nezvinsky - What's Happening With BTC TRX ETH & XRP?!
14	2018-11-20	Robert Johnson - Basketball Legend Kobe Bryant Will Be A Special Guest At TRON's niTRON Summit
15	2019-07-22	Adrian Barkley - Zcash & TRON Show Promise For Future Despite Market Crash
16	2018-11-25	Robert Johnson - TRON CEO Invites eToro CEO To Warren Buffett Lunch This Week
17	2019-02-05	Mark Nezvinsky - Ouch What A Week! Still Good News For XLM ETC And TRX
18	2019-03-04	Robert Johnson - Popular TRON dApps You Need To Try In 2019
19	2020-01-23	Robert Johnson - TRONbet Makes New Records In Betting Volume
20	2019-01-18	Andreas Waechter - TRON Gains And Is Now Second Biggest Dapp Ecosystem
		Adrian Barkley - Justin Sun Announces Decentralised Life Broadcasting Protocol

5 INTERPRETATION OF SENTIMENT INDICES

Table 48. Cryptodaily TRX - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-05-16	Robert Johnson – Justin Sun Slightly Bitter Over TRON CTO Leaving Project
2	2019-07-05	Robert Johnson – Ponzi Scheme Related To TRON Leaves Investors Pointing The Finger At Justin Sun
3	2018-08-29	Robert Johnson – Premined Coins Like XRP TRX XLM And NEO Are Causing Problems For Index Funds
4	2019-07-08	Robert Johnson – Angry Mob Infiltrate TRON Offices
5	2019-05-13	Robert Johnson – TRON Co-Founder Leaves Claiming the Project is No Longer Decentralised
6	2018-07-06	Robert Johnson – TRON Update TRX Price And First TRONICS Volunteers Selected
7	2019-04-25	Robert Johnson – TRON to Partner with Liverpool FC?
8	2019-10-16	Robert Johnson – TRON's Favourite Investor Warren Buffett Makes Confident Bet on Bank of America
9	2019-09-26	Adrian Barkley – TRON CEO Still Trying to Team up with 2020 Presidential Candidate Andrew Yang
10	2019-07-26	Adrian Barkley – Justin Sun Controversy Knocks Down TRX Price By 20%
11	2018-06-12	Robert Johnson – Are TRON And BitTorrent About To Team Up?
12	2018-11-02	Adrian Barkley – \$800 Million Worth Of TRX Burned By Justin Sun
13	2019-12-02	Adrian Barkley – Poloniex Tell Users To 'Buy TRON' In Uncovered Tweet
14	2019-09-24	Adrian Barkley – TRON CEO Reschedules Live Stream On Questions Reading Network
15	2019-07-29	Adrian Barkley – BitTorrent Founder Raises Yet ANOTHER Accusation Against Justin Sun
16	2019-07-24	Adrian Barkley – Following Buffett Lunch Cancellation This Chinese Report Indicates TRON CEO Isn't Able To Leave China
17	2019-06-03	Robert Johnson – Justin Sun Teases Big Announcement For TRON
18	2019-08-05	Adrian Barkley – Is Justin Sun Too Controversial For TRON?
19	2019-12-23	Adrian Barkley – TRON Trademark Hits Roadblock With Disney Situation
20	2018-07-11	Nathan Bentley – Market Update - BTC XLM TRX XMR Down Once More

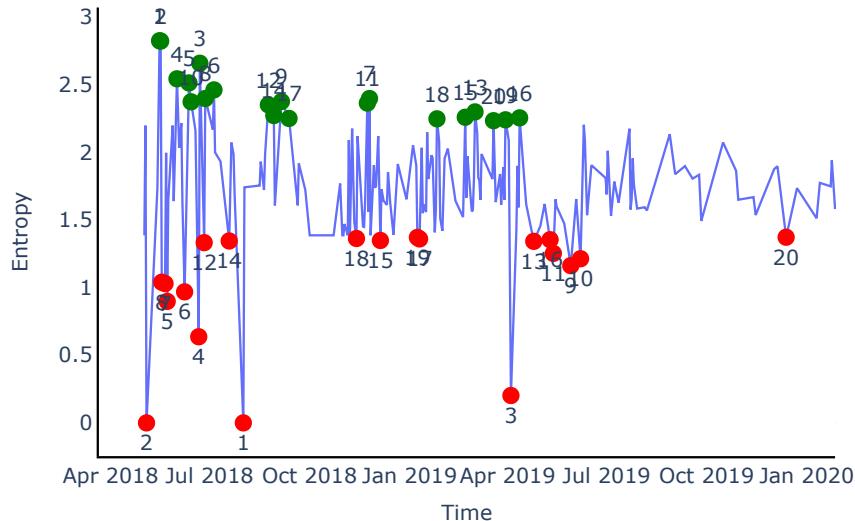


Figure 24. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptodaily TRX

Table 49. Cryptodaily TRX - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-05-16	Nathan Bentley – Why Isn't The TRON MainNet Launch Having An Effect?
2	2018-05-17	Jefe Caan – Cardano (ADA) Could Be Next On Coinbase Along With EOS (EOS) And Tron (TRX)
3	2018-06-22	Robert Johnson – TRON TRX Will Skyrocket After \$50 Million Burn
4	2018-06-01	Robert Johnson – TRON Remains In Disadvantaged Position In The Midst Of MainNet Launch
5	2018-06-12	Robert Johnson – Are TRON And BitTorrent About To Team Up?
6	2018-07-05	Adrian Barkley – Top Four Breakout Coins For July 2018 - BTC EOS TRX & ETC
7	2018-11-25	Mark Nezvinsky – Ouch What A Week! Still Good News For XLM ETC And TRX
8	2018-06-27	Nathan Bentley – TRON Crashing As Market Cap Slips To 11th Place
9	2018-09-05	Robert Johnson – Cardano & TRON Now Included In Abra
10	2018-06-14	Jefe Caan – Cardano (ADA)'s Ouroboros Algorithm Might Be A Better Deal Than EOS (EOS) And TRON (TRX) Combined
11	2018-11-23	Adrian Barkley – TRX Is Being Handed Out By Huobi
12	2018-08-24	Robert Johnson – TRON TRX Adoption Gets Huge Boost
13	2019-03-02	Mark Nezvinsky – LTC Boosts Adoption TRON CEOs Predictions & XRP to leave Coinbase
14	2018-08-29	Robert Johnson – Premined Coins Like XRP TRX XLM And NEO Are Causing Problems For Index Funds
15	2019-02-21	Adrian Barkley – TRX XRP LTC & More Of The Best Cryptos Right Now
16	2019-04-12	Mark Nezvinsky – What's Happening With BTC TRX ETH & XRP?!
17	2018-09-12	Adrian Barkley – Justin Sun (TRON) Still Optimistic On Crypto's Future
18	2019-01-26	Mark Nezvinsky – TRON & EOS Bounce Back This Week
19	2019-03-30	Mark Nezvinsky – WhatsApp To Adopt BTC? Plus Exciting News From TRX & XRP
20	2019-03-19	Robert Johnson – TRON's Past Indicates It's Going The Right Way For Greater Success

Table 50. Cryptodaily TRX - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-08-01	Adrian Barkley – TronWallet Goes Live On Android With iOS Version Incoming Too
2	2018-05-04	Robert Johnson – TRON's Trajectory Tails Off but TRX Will Climb Again Soon
3	2019-04-04	Robert Johnson – TRON CEO Announces Sun Network Could Reach 100x Scalability
4	2018-06-21	Thomas Ramsay – TRX Price Shoots As TRON Foundation Release Odyssey v2.0.3 Token Migration Begins
5	2018-05-23	Thomas Ramsay – TRON Down 10% But Still Managing To Hold Value
6	2018-06-08	Robert Johnson – TRON Remains Flat In Lead Up To Independence Day
7	2018-05-21	Thomas Ramsay – TRON Back In Ninth Place Up 17% There's No Stopping It Now
8	2018-05-18	Thomas Ramsay – TRON to Hit \$0.50 Soon Enough
9	2019-05-29	Adrian Barkley – TRON Continues To Show It's One Of The Best
10	2019-06-07	Robert Johnson – TRON & ETC: Will They Hit All-Time Highs Before EOY?
11	2019-05-13	Robert Johnson – TRON Co-Founder Leaves Claiming the Project is No Longer Decentralised
12	2018-06-26	Nathan Bentley – TRON Coin Migration Complete What Next For TRX?
13	2019-04-25	Robert Johnson – TRON to Partner with Liverpool FC?
14	2018-07-19	Robert Johnson – Ledger Nano S Now Supports Tron (TRX) & ZCoin (XZC)
15	2018-12-05	Adrian Barkley – TRON Transactions Continue To Cruise Past Ethereum
16	2019-05-10	Adrian Barkley – NEO & TRON: Are They on the Same Level?
17	2019-01-10	Robert Johnson – TRON Hires Former SEC Attorney
18	2018-11-13	Robert Johnson – The Expansion Of The TRON Network
19	2019-01-08	Robert Johnson – Earn TRX With TRONGoo
20	2019-12-13	Adrian Barkley – DigiByte Founder Slates TRON As A 'Chinese Government Scan'

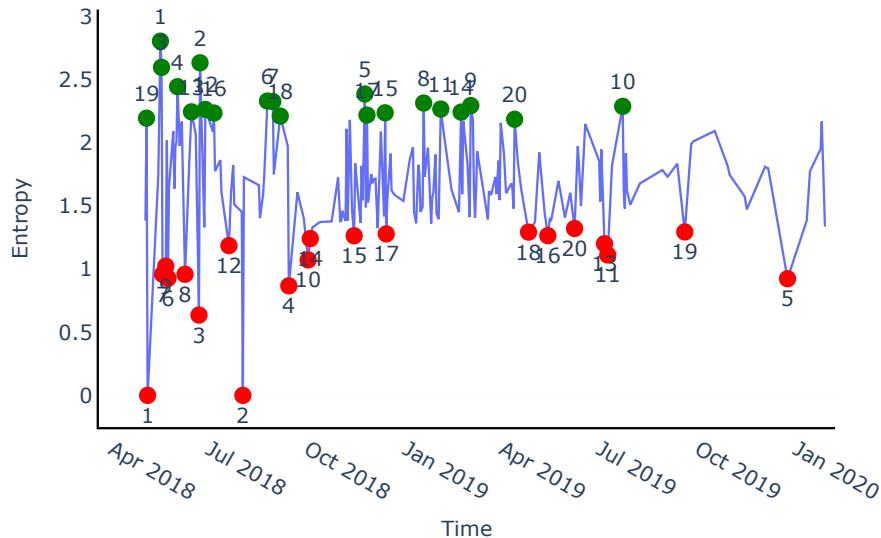


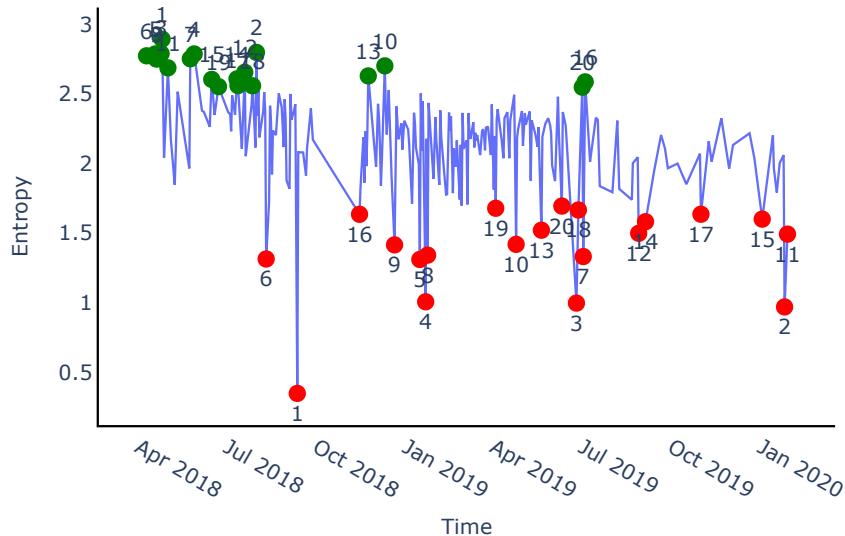
Figure 25. Top-20 articles that caused strongest and lowest sentiment - Cryptodaily TRX

Table 51. Cryptodaily TRX - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-05-16	Nathan Bentley – Why Isn't The TRON MainNet Launch Having An Effect?
2	2018-06-22	Robert Johnson – TRON TRX Will Skyrocket After \$50 Million Burn
3	2018-05-17	Jefe Caan – Cardano (ADA) Could Be Next On Coinbase Along With EOS (EOS) And Tron (TRX)
4	2018-06-01	Robert Johnson – TRON Remains In Disadvantaged Position In The Midst Of MainNet Launch
5	2018-11-23	Adrian Barkley – TRX Is Being Handed Out By Huobi
6	2018-08-24	Robert Johnson – TRON TRX Adoption Gets Huge Boost
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8	2019-01-17	Adrian Barkley – Why TRX ETH & XRP Could Each See A Bull Run In 2019
9	2019-03-02	Mark Nezvinsky – LTC Boosts Adoption TRON CEOs Predictions & XRP to leave Coinbase
10	2019-07-22	Robert Johnson – TRON CEO Invites eToro CEO To Warren Buffett Lunch This Week
11	2019-02-02	bMark Nezvinsky – XRP Whale Weiss Ratings Confront TRX & Could ADA Be The Next BTC?
12	2018-06-27	Nathan Bentley – TRON Crashing As Market Cap Slips To 11th Place
13	2018-06-14	Jefe Caan – Cardano (ADA)'s Ouroboros Algorithm Might Be A Better Deal Than EOS (EOS) And TRON (TRX) Combined
14	2019-02-21	Adrian Barkley – TRX XRP LTC & More Of The Best Cryptos Right Now
15	2018-12-12	Robert Johnson – TRX Network Sees New Decentralised Exchange Go Live
16	2018-07-05	Adrian Barkley – Top Four Breakout Coins For July 2018 - BTC EOS TRX & ETC
17	2018-11-25	Mark Nezvinsky – Ouch What A Week! Still Good News For XLM ETC And TRX
18	2018-09-05	Robert Johnson – Cardano & TRON Now Included In Abra
19	2018-05-03	Robert Johnson – New Listing May Pull TRON Up to \$0.10
20	2019-04-12	Mark Nezvinsky – What's Happening With BTC TRX ETH & XRP?!

Table 52. Cryptodaily TRX - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-05-04	Thomas Ramsay - Crypto Daily – The Crypto Refresh
2	2018-08-01	Adrian Barkley – TronWallet Goes Live On Android With iOS Version Incoming Too
3	2018-06-21	Thomas Ramsay – TRX Price Shoots As TRON Foundation Release Odyssey v2.0.3 Token Migration Begins
4	2018-09-13	Robert Johnson – You Can Now Swap TRON For Alternative Other Coins
5	2019-12-23	Adrian Barkley – TRON Trademark Hits Roadblock With Disney Situation
6	2018-05-23	Thomas Ramsay – TRON Down 10% But Still Managing To Hold Value
7	2018-05-18	Thomas Ramsay – TRON to Hit \$0.50 Soon Enough
8	2018-06-08	Robert Johnson – TRON Remains Flat In Lead Up To Independence Day
9	2018-05-21	Thomas Ramsay – TRON Back In Ninth Place Up 17% There's No Stopping It Now
10	2018-10-01	Nathan Bentley – BitTorrent Announce TRX Payment Platform
11	2019-07-08	Robert Johnson – Angry Mob Infiltrate TRON Offices
12	2018-07-19	Robert Johnson – Ledger Nano S Now Supports Tron (TRX) & ZCoin (XZC)
13	2019-07-05	Robert Johnson – Ponzi Scheme Related To TRON Leaves Investors Pointing The Finger At Justin Sun
14	2018-10-03	Adrian Barkley – The TRON Wallet Is Always Improving
15	2018-11-13	Robert Johnson – The Expansion Of The TRON Network
16	2019-05-13	Robert Johnson – TRON Co-Founder Leaves Claiming the Project is No Longer Decentralised
17	2018-12-13	Adrian Barkley – Have You Seen TRONs Christmas Giveaway?
18	2019-04-25	Robert Johnson – TRON to Partner with Liverpool FC?
19	2019-09-18	Robert Johnson – Justin Sun Donating More than \$1 Million For UBI Program By US Presidential Hopeful
20	2019-06-07	Robert Johnson – TRON & ETC: Will They Hit All-Time Highs Before EOY?

**Figure 26.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptodaily XRP**Table 53.** Cryptodaily XRP - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-04-25	Nathan Bentley – Who Wants To Know What's Really Behind Ripple's Success
2	2018-07-31	Adrian Barkley – The Celebrities Of XRP Who's Who?
3	2018-04-24	Jefe Caan – Is Stellar (XLM) A Safer Bet Than Ripple (XRP)?
4	2018-05-28	'Nathan Bentley – The Crypto Refresh May 28th
5	2018-04-18	Jefe Caan – Indecisive Bitcoin (BTC) Could Slow Down Ripple (XRP) Rally
6	2018-04-09	Jefe Caan – Ripple (XRP): Why So Biased?
7	2018-05-24	Jefe Caan – Ripple (XRP) Eyes Reversal While Being Down 82% From All Time High
8	2018-04-20	Jefe Caan – Can Ripple (XRP) And Bitcoin Cash (BCH) Sustain Their Recent Gains?
9	2018-04-19	Jefe Caan – Bitcoin (BTC) Could Reverse Exuberant Ripple (XRP) And Stellar (XLM) Gains
10	2018-12-10	Adrian Barkley – Coinbase To List XRP Soon
11	2018-05-01	Jefe Caan – Ripple (XRP) May Have Room For Further Downside
12	2018-07-19	Jefe Caan – Ripple (XRP): Striking Similarities Between 2017 And 2018 Fractals
13	2018-11-23	Robert Johnson – People Love Working At Ripple
14	2018-07-11	Robert Johnson – XRP Looks Less Volatile Than Bitcoin So Is More Attractive To New Investors
15	2018-06-15	Jefe Caan – Is Ripple (XRP) About To Be Classified As A Security?
16	2019-07-04	Robert Johnson – David Schwartz: 'We Need Our Competitors To Succeed. We Need The Ecosystem To Succeed'
17	2018-07-12	Nathan Bentley – Market Update - XRP BCH EOS And LTC Continue To Fall
18	2018-07-27	Robert Johnson – Charlie Lee Believes That XRP Is Like Diamond
19	2018-06-22	Nathan Bentley – Ripple XRP Isn't A Cryptocurrency It's A Crypto 2.0
20	2019-07-01	Robert Johnson – Cryptocurrency Can Be Safer Than You Think

Table 54. Cryptodaily XRP - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-09-11	Robert Johnson – Ripple’s Legal Battle Comes To An End Agreement
2	2020-01-25	Adrian Barkley – Ripple Insights Becomes the Face of New Phishing Scam
3	2019-06-25	Siebe Slagter – Litecoin’s (LTC) 4.3% Plunge Knocks CD 21 Leaders Index Lower to 54.72
4	2019-01-21	Jefe Caan – Ripple (XRP) Poised For A Major Rally Against Bitcoin (BTC) In Weeks Ahead
5	2019-01-15	Adrian Barkley – Why Ripple (XRP) Will Continue To Grow This Year
6	2018-08-10	Adrian Barkley – How XRP Could Improve The Football Transfer Window
7	2019-07-02	Adrian Barkley – XRP Vs XLM The Kings Of Cross Border Payments
8	2019-01-23	Adrian Barkley – The Future Of XRP And xRapid According To Major US Credit Union
9	2018-12-20	Robert Johnson – Garlinghouse: XRP Is Not A Security
10	2019-04-24	Robert Johnson – Is It Time To Sell XRP?
11	2020-01-28	Adrian Barkley – Are XRP and XLM competitors?
12	2019-08-28	Adrian Barkley – Garlinghouse Intends to Clear up Concerns on XRP Token
13	2019-05-20	Jefe Caan – Ripple (XRP): Decline To \$0.15 Likely As Price Demonstrates Extreme Weakness
14	2019-09-04	Robert Johnson – Ripple CTO: ‘I am Concerned About XRP Distribution’
15	2020-01-02	Sally Ho – 2 January 2020 - XRP/BTC - Weekly
16	2018-11-14	Brian Wilson – The Daily Two - What’s the Difference Between Cryptocurrency & Digital Currency
17	2019-10-31	Adrian Barkley – Why Ripple Will Thrive During A Global Recession
18	2019-06-27	Robert Johnson – The Future Of Ripple XRP
19	2019-04-03	Robert Johnson – The Bitcoin Debate: Why Coinbase Didn’t Choose BTC Over XRP
20	2019-06-10	Robert Johnson – Ripple Promise To Make XRP More Accurate

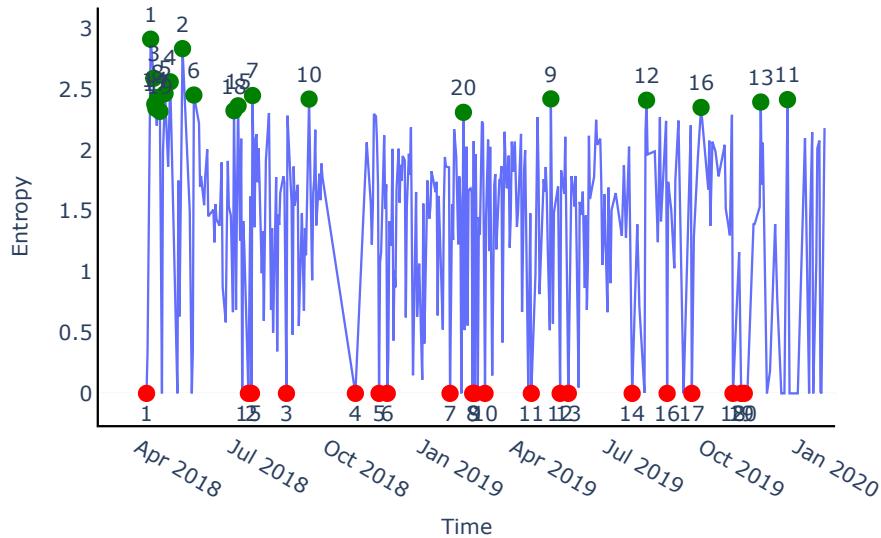


Figure 27. Top-20 articles that caused strongest and lowest positive sentiment - Cryptodaily XRP

Table 55. Cryptodaily XRP - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-04-13	Nathan Bentley – These 3 Things Could Sky Rocket The Price Of Ripple XRP
2	2018-05-14	Robert Johnson – Ripple's Xpring Is Great For XRP
3	2018-04-16	Robert Johnson – Ripple & Apple Partnership Has The Potential To Sky Rocket XRP Price
4	2018-05-02	Thomas Ramsay – Oman Banking Sector Makes Connection With Ripple
5	2018-04-27	Nathan Bentley – Big Exchange Listing For Ripple & Bitcoin Cash
6	2018-05-25	Thomas Ramsay – Ripple XRP And Bitcoin Cash Now Live On Revolut
7	2018-07-21	Robert Johnson – XRP Is Digital Fiat Not Real Cryptocurrency
8	2018-04-20	Jefe Caan – Can Ripple (XRP) And Bitcoin Cash (BCH) Sustain Their Recent Gains?
9	2019-05-07	Adrian Barkley – Ripple Launch New 4.0 Update: 200 Banks to Integrate xRapid
10	2018-09-14	Adrian Barkley – NCB Joins RippleNet
11	2019-12-23	Robert Johnson – Ripple See 2020 To Be A Good Year For Institutional Players & Adoption
12	2019-08-08	Adrian Barkley – The Markets Are Flying High Bitcoin XRP Ethereum Up
13	2019-11-27	Adrian Barkley – TransferGo Wanting to Adopt Ripple-Based ODL Solution
14	2018-04-17	Jefe Caan – Ripple (XRP) Vs. Stellar (XLM): Which Coin Has The Brightest Future?
15	2018-07-07	Nathan Bentley – ZuckCoin And Ripple XRP Payments On Facebook Messenger The Possibilities Are Endless
16	2019-09-30	Adrian Barkley – Ripple Expand into Iceland With New Acqui-Hire
17	2018-04-18	Jefe Caan – Indecisive Bitcoin (BTC) Could Slow Down Ripple (XRP) Rally
18	2018-07-03	Robert Johnson – Head Of Innovation At Santander UK Speaks Out About Ripple And OnePayFX
19	2018-04-22	Frankie Crowhurst – Here's Why Ripple Is Doing So Well
20	2019-02-11	Mark Nezvinsky – How Will These New Regulations Impact XRP And Stellar?

Table 56. Cryptodaily XRP - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-04-09	Jefe Caan – Ripple (XRP): Why So Biased?
2	2018-07-20	Adrian Barkley – IMF Bullish On Ripple XRP
3	2018-08-23	Robert Johnson – The XRP Ledger Is Now Fully Decentralised According To Ripple CTO
4	2018-10-29	Robert Johnson – XRP Sales Double In Q3 2018
5	2018-11-21	Adrian Barkley – XRP Hits Stumbling Block
6	2018-11-29	Adrian Barkley – Low-Cost XRP Transactions Are Better Than Ever
7	2019-01-29	Robert Johnson – Whales In Season As Billions Of XRP Moved
8	2019-02-20	Jefe Caan – Ripple (XRP) Just Formed A Gravestone Doji Trading Against Bitcoin (BTC)
9	2019-02-22	Jefe Caan – Is Ripple (XRP) Ready For Another Death Cross?
10	2019-03-04	Jefe Caan – Ripple (XRP) About To Exit Symmetrical Triangle Big Moves Expected Ahead
11	2019-04-18	Mark Nezvinsky – This Weeks Exciting Crypto Updates: Bitcoin SV xRapid and Notre-Dame
12	2019-05-16	Jefe Caan – Ripple (XRP) In Free fall As Price Faces Rejection At Key Trend Line Resistance
13	2019-05-24	Mark Nezvinsky – Weekly Roundup: ETF Delay Ripple Banks & Bitconnect's Dreaded Return
14	2019-07-25	Robert Johnson – Ripple's Second Quarter Report Released - \$250m Spike In XRP Sales
15	2018-07-17	Robert Johnson – Ripple XRP Expected For More Gains
16	2019-08-28	Adrian Barkley – Garlinghouse Intends to Clear up Concerns on XRP Token
17	2019-09-21	Adrian Barkley – How xRapid is Making Waves Worldwide
18	2019-10-31	Adrian Barkley – Why Ripple Will Thrive During A Global Recession
19	2019-11-08	Sally Ho – 8 November 2019 XRP/USD Hourly
20	2019-11-11	Robert Johnson – Thinking Of Hiding Your XRP Tax Think Again

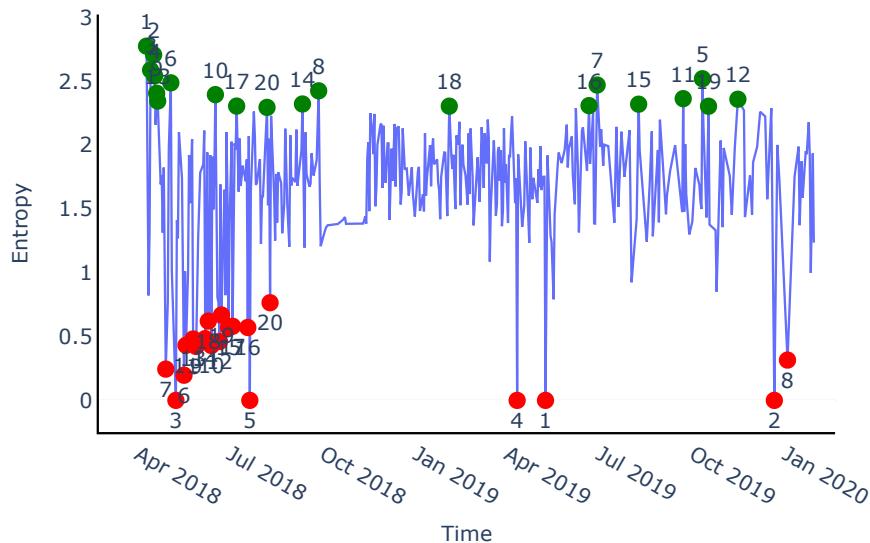


Figure 28. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptodaily XRP

Table 57. Cryptodaily XRP - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-04-09	Jefe Caan – Ripple (XRP): Why So Biased?
2	2018-04-16	Robert Johnson – Ripple & Apple Partnership Has The Potential To Sky Rocket XRP Price
3	2018-04-13	Nathan Bentley – These 3 Things Could Sky Rocket The Price Of Ripple XRP
4	2018-04-17	Jefe Caan – Ripple (XRP) Vs. Stellar (XLM): Which Coin Has The Brightest Future?
5	2019-10-10	Robert Johnson – Ripple's New Partner Will Help Its Global Expansion of Cross Border Payments
6	2018-05-03	Thomas Ramsay – Ripple Will Protect Customers to Enable Innovation Could the UK Adopt XRP First?
7	2019-06-28	Robert Johnson – Ripple's xRapid Platform Goes Live With New Jersey Startup
8	2018-09-26	Nathan Bentley – One Thing The Markets Tell Us Today Coinbase NEEDS XRP
9	2018-04-19	Jefe Caan – Bitcoin (BTC) Could Reverse Exuberant Ripple (XRP) And Stellar (XLM) Gains
10	2018-06-16	Nathan Bentley – Ripple To See A Positive Trend With This News
11	2019-09-21	Adrian Barkley – How xRapid is Making Waves Worldwide
12	2019-11-14	Robert Johnson – Ripple CEO on SWIFT & XRP's Future
13	2018-04-20	Jefe Caan – Can Ripple (XRP) And Bitcoin Cash (BCH) Sustain Their Recent Gains?
14	2018-09-10	Robert Johnson – Are Ripple Competitors Of Stellar?
15	2019-08-08	Adrian Barkley – The Markets Are Flying High Bitcoin XRP Ethereum Up
16	2019-06-20	Mark Nezvinsky – LTC & XRP: Could Litecoin Flip XRP Before It Halves?
17	2018-07-07	Nathan Bentley – ZuckCoin And Ripple XRP Payments On Facebook Messenger The Possibilities Are Endless
18	2019-02-02	Mark Nezvinsky – XRP Whale Weiss Ratings Confront TRX & Could ADA Be The Next BTC?
19	2019-10-16	Robert Johnson – XRP Sees Gains - Community Gets Bullish Again
20	2018-08-06	Adrian Barkley – Market Update - Shaky Start To August Pulls BTC ETH XRP BCH And EOS Down

Table 58. Cryptodaily XRP - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2019-05-08	Jefe Caan – Will Ripple (XRP) Rise Above \$3 Ever Again?
2	2019-12-20	Adrian Barkley – How To Use XRP To Fight Off Spam
3	2018-05-08	Thomas Ramsay – Bitcoin & Ethereum Continue To Soar Ripple Struggles
4	2019-04-10	Adrian Barkley – xRapid Honoured at World Changing Ideas Awards
5	2018-07-20	Adrian Barkley – IMF Bullish On Ripple XRP
6	2018-05-16	Thomas Ramsay – Is XRP Going To Skyrocket At The Ripple Community Night Could XRP See \$1.00?
7	2018-04-28	Frankie Crowhurst – How The First Quarter Has Affected Ripple
8	2020-01-02	Sally Ho – 2 January 2020 - XRP/BTC - Weekly
9	2018-05-28	Robert Johnson – Are Ripple About To Partner With Amazon?
10	2018-06-12	Nathan Bentley – Evidence That A Coinbase Listing Would See Ripple XRP Skyrocket
11	2018-05-18	Nathan Bentley – When Ripple Takes On Its Rivals XRP Could Hit \$5.00
12	2018-06-20	Robert Johnson – High Chance Amazon Will Partner With Ripple (XRP) In 2018
13	2018-05-25	Thomas Ramsay – Ripple XRP And Bitcoin Cash Now Live On Revolut
14	2018-06-06	Thomas Ramsay – A Bull Run Now Will See Ripple XRP Up 103% Then XRP Could Hit \$2.00
15	2018-06-29	Nathan Bentley – Did PayPal Purchase Hyperwallet Using Ripple XRP?
16	2018-07-18	Adrian Barkley – Ripple XRP Can Legally Be Listed On Coinbase
17	2018-07-03	Nathan Bentley – A New Series Called 'The Ripple Drop' Set To Launch Soon
18	2018-06-09	Nathan Bentley – The Crypto Refresh June 8th 2018
19	2018-06-22	Nathan Bentley – Now We Know That Ripple XRP Will Be Added To Coinbase Will XRP See \$3.00 Again?
20	2018-08-09	Robert Johnson – Ripple Tangled Into Another XRP Securities Lawsuit By Rosen Law Firm

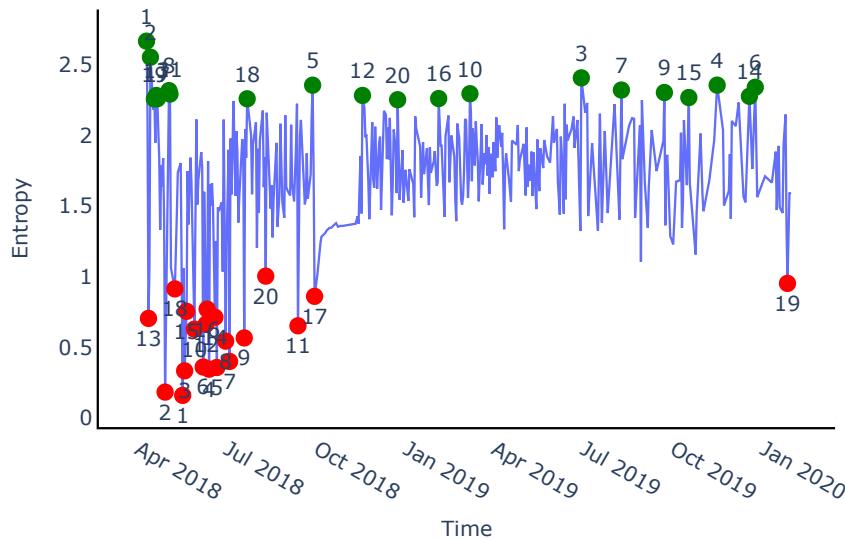


Figure 29. Top-20 articles that caused strongest and lowest sentiment - Cryptodaily XRP

Table 59. Cryptodaily XRP - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-04-09	Jefe Caan – Ripple (XRP): Why So Biased?
2	2018-04-13	Nathan Bentley – These 3 Things Could Sky Rocket The Price Of Ripple XRP
3	2019-06-28	Robert Johnson – Ripple's xRapid Platform Goes Live With New Jersey Startup
4	2019-11-14	Robert Johnson – Ripple CEO on SWIFT & XRP's Future
5	2018-09-26	Nathan Bentley – One Thing The Markets Tell Us Today Coinbase NEEDS XRP
6	2019-12-23	bRobert Johnson – Ripple See 2020 To Be A Good Year For Institutional Players & Adoption
7	2019-08-08	Adrian Barkley – The Markets Are Flying High Bitcoin XRP Ethereum Up
8	2018-05-02	Thomas Ramsay – Oman Banking Sector Makes Connection With Ripple
9	2019-09-21	Adrian Barkley – How xRapid is Making Waves Worldwide
10	2019-03-06	Jefe Caan – Ripple (XRP) Bulls Not Ready To Take Control Just Yet
11	2018-05-03	Thomas Ramsay – Ripple Will Protect Customers to Enable Innovation Could the UK Adopt XRP First?
12	2018-11-16	Adrian Barkley – Despite Market Declining XRP & XLM Flourish
13	2018-04-19	Jefe Caan – Bitcoin (BTC) Could Reverse Exuberant Ripple (XRP) And Stellar (XLM) Gains
14	2019-12-17	Robert Johnson – XRP's 'Direction Of Integration' Changed At The End Of November For The Rest Of The Market
15	2019-10-16	Robert Johnson – XRP Sees Gains - Community Gets Bullish Again'
16	2019-02-02	Mark Nezvinsky – XRP Whale Weiss Ratings Confront TRX & Could ADA Be The Next BTC?
17	2018-04-20	Jefe Caan – Can Ripple (XRP) And Bitcoin Cash (BCH) Sustain Their Recent Gains?
18	2018-07-21	Robert Johnson – XRP Is Digital Fiat Not Real Cryptocurrency
19	2018-04-17	Jefe Caan – Ripple (XRP) Vs. Stellar (XLM): Which Coin Has The Brightest Future?
20	2018-12-22	Mark Nezvinsky – What A Week For IOTA XRP And USDT

Table 60. Cryptodaily XRP - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-05-16	Thomas Ramsay – Is XRP Going To Skyrocket At The Ripple Community Night Could XRP See \$1.00?
2	2018-04-28	Frankie Crowhurst – How The First Quarter Has Affected Ripple
3	2018-05-18	Nathan Bentley – When Ripple Takes On Its Rivals XRP Could Hit \$5.00
4	2018-06-12	Nathan Bentley – Evidence That A Coinbase Listing Would See Ripple XRP Skyrocket
5	2018-06-20	Robert Johnson – High Chance Amazon Will Partner With Ripple (XRP) In 2018
6	2018-06-06	Thomas Ramsay – A Bull Run Now Will See Ripple XRP Up 103% Then XRP Could Hit \$2.00
7	2018-07-03	Nathan Bentley – A New Series Called - The Ripple Drop Set To Launch Soon
8	2018-06-29	Robert Johnson – This Is How Much Ripple XRP Could Rise In The Next Bull Run
9	2018-07-18	Adrian Barkley – Ripple XRP Can Legally Be Listed On Coinbase
10	2018-05-28	Robert Johnson – Are Ripple About To Partner With Amazon?
11	2018-09-11	Robert Johnson – Ripple's Legal Battle Comes To An End Agreement
12	2018-06-09	Nathan Bentley – The Crypto Refresh June 8th 2018
13	2018-04-11	Nathan Bentley – Ripples Progress Is Proof That XRP Will Work
14	2018-06-18	Thomas Ramsay – Confirmation Regarding Ripple XRP As A Security What's Been Said?
15	2018-05-20	Robert Johnson – Why Volatility Is Not A Problem For Ripple
16	2018-06-10	Robert Johnson – Ripple XRP Still Chasing Top US Exchanges
17	2018-09-28	Robert Johnson – With September Passing What Does October Hold For Bitcoin Ethereum & XRP
18	2018-05-08	Thomas Ramsay – Bitcoin & Ethereum Continue To Soar Ripple Struggles
19	2020-01-25	Adrian Barkley – Ripple Insights Becomes the Face of New Phishing Scam
20	2018-08-09	Robert Johnson – Ripple Tangled Into Another XRP Securities Lawsuit By Rosen Law Firm

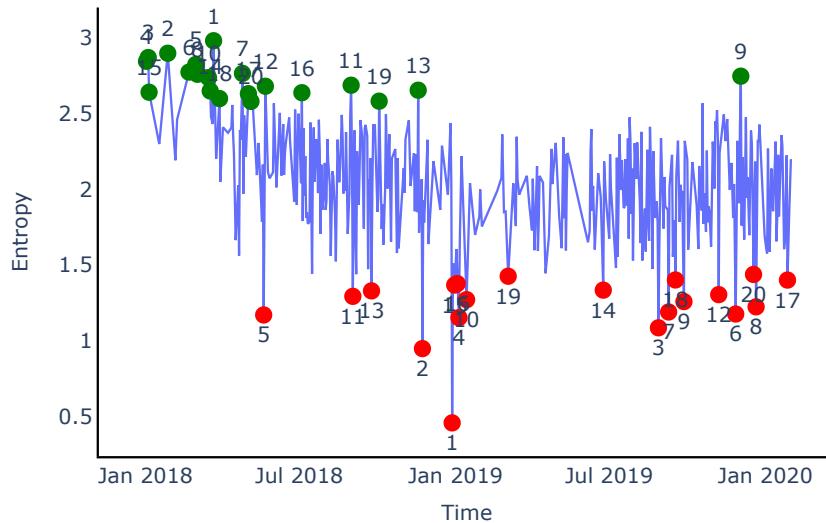


Figure 30. Top-20 articles that caused strongest and lowest negative sentiment - Cryptoslate BTC

Table 61. Cryptoslate BTC - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-03-22	Jose Lanz – Twitter CEO Believes Bitcoin Will Become the World's Most Valuable Currency
2	2018-01-27	Dylan Dedi – People Demand Retailers Embrace Crypto with Trending #PayWithCrypto Hashtag
3	2018-01-04	Bill DeLisle – Bitcoin Futures Contracts Underwhelm In First Month of Trading
4	2018-01-02	Bill DeLisle – Bitcoin Rises After Peter Thiel Announces Big Investment
5	2018-03-01	Ali Raza – Square CEO Jack Dorsey Believes App Will Eventually Do More Than Just Buy and Sell Bitcoin
6	2018-02-21	Sam Town – Japanese Exchange Glitch Allows Trader to Claim \$21 Trillion in Free Bitcoin
7	2018-04-25	Peter Ivancic – The Bitcoin ATM Black Market: Regulatory Blind Spot Allows Crypto Traders To Subvert KYC Requirements
8	2018-03-03	Sam Town – Top Exchanges Slash Bitcoin Transaction Fees as SegWit Adoption Spreads
9	2019-12-03	Priyeshu Garg – The crypto industry is getting an ally in the U.S. Senate
10	2018-03-16	Bill DeLisle – Barclays Announces Partnership with Coinbase
11	2018-08-31	Jonathan Kim – Satis Group Research Forecasts Bitcoin at \$144000 by 2028
12	2018-05-22	Jacob Tuwiner – Pantera Capital CEO Dan Morehead Talks Bitcoin and Blockchain
13	2018-11-18	Joseph Young – Jihan Wu May Sell 1 Million Bitcoin Cash SV
14	2018-03-18	Sam Town – No The Mt. Gox Sell-Off is Not to Blame for Market Dip
15	2018-01-05	Bill DeLisle – Would a Bitcoin Slump Actually Affect the Stock Market?
16	2018-07-04	David Lee – Bitcoin Hackers Monitoring 2.3 Million Bitcoin Addresses
17	2018-05-02	Wim Olivier – Bitcoin and Crypto Intrigue Inside of India
18	2018-03-29	Bill DeLisle – Cboe Once Again Encouraging SEC to Allow Bitcoin ETFs
19	2018-10-03	Shaurya Malwa – Coinbase Leverages 'Child Payments' to Enhance Bitcoin (BTC) Transactions
20	2018-05-05	Jacob Tuwiner – London Authorities Seize \$700000 in Bitcoin from Cybercriminal

Table 62. Cryptoslate BTC - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-12-28	Priyeshu Garg – BlockTower Capital to Lose \$1 Million After Betting Bitcoin Would Hit \$50
2	2018-11-23	Priyeshu Garg – Why It's Overkill to Compare the Bitcoin Slowdown With History's Biggest Bubble Bursts
3	2019-08-28	Mitchell Moos – Gold forgery crisis demonstrates the need for Bitcoin
4	2019-01-05	Mitchell Moos – Ethereum
5	2018-05-20	Sam Town – Alibaba Founder Bullish About Blockchain But Doesn't Care For Bitcoin
6	2019-11-27	Priyeshu Garg – Crypto community urges Jack Dorsey to memorialize Bitcoin pioneer Hal Finney's Twitter account
7	2019-09-09	Priyeshu Garg – Bakkt launches institutional Bitcoin custody service with \$125 million in insurance
8	2019-12-21	Nick Chong – Bitcoin price defends key uptrend
9	2019-09-27	Ali Martinez – Is Bitcoin's price correlated with CME Bitcoin futures?
10	2019-01-14	Mitchell Moos – Is Russia's Alleged \$10 Billion Bitcoin Investment Fake News?
11	2018-09-02	Joseph Young – Trader: Ethereum is More Vulnerable Than Bitcoin to a Major Correction
12	2019-11-07	Joseph Young – As Bitcoin dominance doubles
13	2018-09-24	Joseph Young – Bitcoin Core Dev Takes Responsibility for Critical Bug: I'm Embarrassed and Sorry
14	2019-06-24	Ali Martinez – Bitcoin could break \$20
15	2018-12-31	Mitchell Moos – Analysis: Bitcoin Transactions at 10-Month High While Fees at 2-Year Low
16	2019-01-03	Mitchell Moos – Bitcoin and Bitcoin Cash Getting Gaslit by Craig Wright and Calvin Ayre?
17	2020-01-27	Joseph Young – Analyst: Contrary to popular belief
18	2019-09-17	Ali Martinez – Bitcoin SegWit transactions hit a new all-time high
19	2019-03-04	Priyeshu Garg – Bitcoin Lightning Network Reaches 30K Channels and 7K Nodes with Support from Jack Dorsey
20	2019-12-18	Priyeshu Garg – [Op-Ed] The curse of permabulls: Why you need to stop listening to Bitcoin maximalists

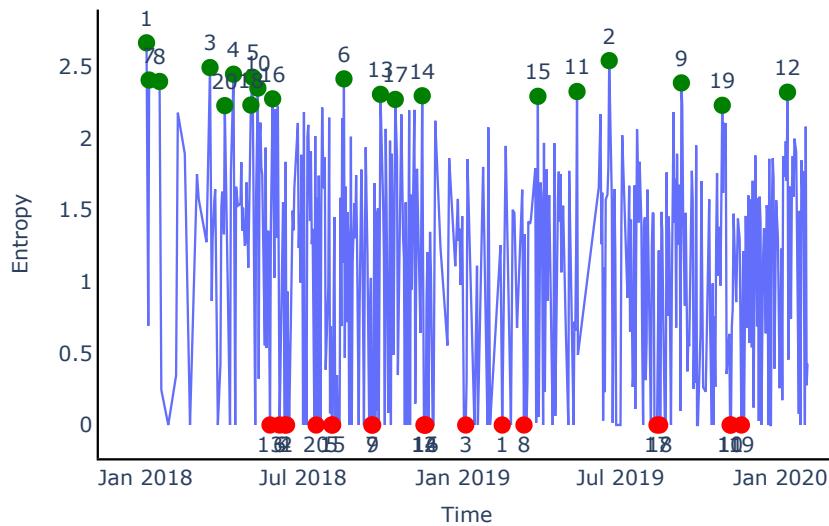
**Figure 31.** Top-20 articles that caused strongest and lowest positive sentiment - Cryptoslate BTC

Table 63. Cryptoslate BTC - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-01-02	Bill DeLisle – Bitcoin Rises After Peter Thiel Announces Big Investment
2	2019-06-18	Jonnie Emsley – Binance launching Bitcoin-pegged token on Binance Chain other coins to follow
3	2018-03-16	Bill DeLisle – Barclays Announces Partnership with Coinbase
4	2018-04-12	Peter Ivancic – Canadian Peer-to-Peer Trading Explodes Due to Bank Restrictions on Crypto Purchases
5	2018-05-04	Jonathan Kim – Bitcoin Banknotes Released in Singapore to Encourage Mass Adoption
6	2018-08-17	Shaurya Malwa – Bitcoin Permabull Pantera Capital Details \$175 Million Crypto-Fund
7	2018-01-05	Bill DeLisle – Would a Bitcoin Slump Actually Affect the Stock Market?
8	2018-01-17	Bill DeLisle – Examining the True Decentralization of Bitcoin and Ethereum
9	2019-09-09	Jonnie Emsley – Bitcoin rockets to \$2250 premium in Argentina after President Macri imposes capital controls
10	2018-05-10	Jonathan Kim – Huawei Giving Chinese Public Access to Bitcoin Wallet Through AppGallery
11	2019-05-12	Priyeshu Garg – Binance and Coinbase see major spike in traffic as Bitcoin jumped in 2019
12	2020-01-09	Nick Chong – Why a top executive expects Bitcoin to surge 150% in 2020
13	2018-09-28	John Bogna – Watchmaker Hublot Announces Commemorative Watch Only Buyable With Bitcoin
14	2018-11-15	Priyeshu Garg – Bitcoin Lightning Network Reaches All-Time High Capacity
15	2019-03-28	Priyeshu Garg – LocalBitcoins Introduces New Verifications Reducing Anonymity After EU Regulation
16	2018-05-27	Peter Ivancic – GMO to Release World's First 7nm Bitcoin Mining Card
17	2018-10-15	Pat Larsen – Bitcoin is Anti-Fragile Skin in the Game
18	2018-05-02	Wim Olivier – Bitcoin and Crypto Intrigue Inside of India
19	2019-10-26	Nick Chong – Crypto community reacts to Chinese President Xi Jinping's endorsement of blockchain
20	2018-04-02	Matthew North – World's 9th Largest Stock Exchange To Launch Cryptocurrency Brokerage

Table 64. Cryptoslate BTC - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-02-15	Darryn Pollock – Nasdaq Will Provide Real-Time Bitcoin and Ethereum Index Information
2	2018-06-12	Jonnie Emsley – Switzerland Runs Referendum for Bitcoin-Like Financial System
3	2019-01-04	Priyeshu Garg – Bitcoin's Latest Buying Streak Could Mean a Rise in Prices
4	2018-06-10	Jacob Tuwiner – Bitcoin Dives Below \$7000 Support Level Following Korean Exchange Hack
5	2018-08-03	Joseph Young – Why Major Crypto Exchange OKEx Controversially Used User Funds to Liquidate Bitcoin Contract
6	2018-06-04	David Lee – Apple Co-Founder Steve Wozniak Joins Other Tech Luminaries in Rooting For Bitcoin as Global Currency
7	2018-09-18	Shaurya Malwa – Bitcoin Hash Rate Doubles in Three Months Mining Now Costlier Than Buying One BTC
8	2019-03-12	Priyeshu Garg – Bitcoin and Binance in Real-Estate: Australia to Hold World's First Live Property Auction Using Crypto
9	2018-09-19	John Bogna – Hackers Using Software Vulnerability Stolen From the NSA to Illicitly Mine Crypto
10	2019-11-04	Priyeshu Garg – Data shows no increase in Bitcoin withdrawals following BitMEX email leak
11	2019-11-05	Priyeshu Garg – Can the Bitcoin Lightning Network enable truly secure messaging? This developer thinks so
12	2018-11-17	Shaurya Malwa – Nvidia Stock Plunges as Chip Sales Plunge With Bitcoin Prices
13	2018-05-24	Bill DeLisle – DOJ Is Investigating Bitcoin Price Manipulation
14	2018-11-18	Joseph Young – Jihan Wu May Sell 1 Million Bitcoin Cash SV
15	2018-08-04	Jonathan Kim – Mt.Gox Creditors Revise Proposal to Claim Bitcoin Repayments
16	2018-11-19	Mitchell Moos – Bitcoin Bloodbath Continues: Price Hits 5000MarketLoses45 Billion
17	2019-08-12	Priyeshu Garg – Researcher: Craig Wright refusing to move his coins in 2016 should have been a major red flag
18	2019-08-15	Jonnie Emsley – Alleged Bitcoin Ponzi scheme Plus Token could be liquidating billions of dollars in stolen crypto says VC
19	2019-11-17	Cole Petersen – Data shows retail interest in Bitcoin plateauing as BTC price stagnates
20	2018-07-16	Shaurya Malwa – Research: Quantum Computers Can Decipher Private Keys of Cryptocurrencies

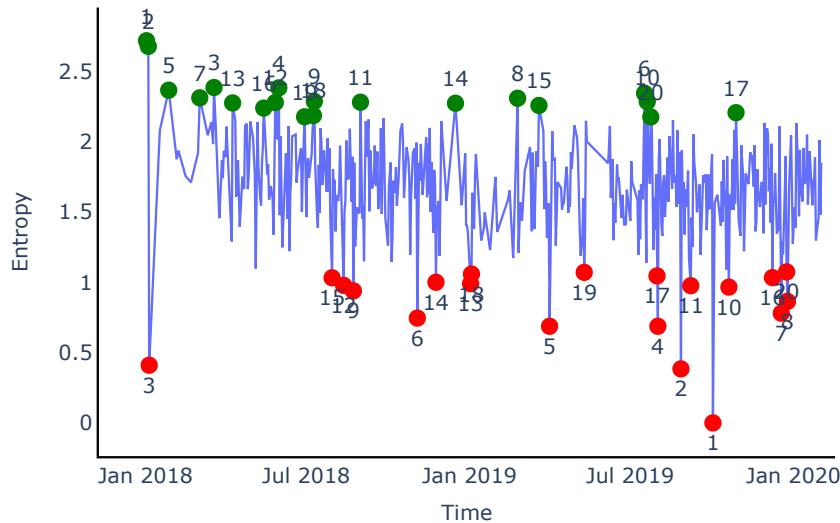


Figure 32. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptoslate BTC

Table 65. Cryptoslate BTC - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-02	Bill DeLisle – Bitcoin Rises After Peter Thiel Announces Big Investment
2	2018-01-04	Bill DeLisle – Bitcoin Futures Contracts Underwhelm In First Month of Trading
3	2018-03-19	Sam Town – Bitcoin vs WoW Gold: Why Aren't Cryptos Treated Like In-Game Currencies?
4	2018-05-31	Peter Ivancic – Bitcoin Scalability Update: SegWit Transaction Efficiency and Lightning Network Implementation
5	2018-01-27	Dylan Dedi – People Demand Retailers Embrace Crypto with Trending #PayWithCrypto Hashtag
6	2019-07-17	Omar Faridi – Institutional demand for Bitcoin and Ethereum causes Grayscale AUM to nearly triple reduces exposure to XRP
7	2018-03-03	Sam Town – Top Exchanges Slash Bitcoin Transaction Fees as SegWit Adoption Spreads
8	2019-02-24	Mitchell Moos – Bitcoin Transactions Are Steadily Growing at January 2018 Levels
9	2018-07-10	Avi Felman – Chinese Yuan Now Below 1% of Total Bitcoin Trading Volume Down From Peak of 90%
10	2019-07-20	Omar Faridi – Binance Research: most large Bitcoin and Ethereum investors hold stablecoins use cold wallets
11	2018-08-31	Jonathan Kim – Satis Group Research Forecasts Bitcoin at \$144000 by 2028
12	2018-05-27	Peter Ivancic – GMO to Release World's First 7nm Bitcoin Mining Card
13	2018-04-09	Shiraz Jagati – Bitcoin Drops Back Below \$7000 As Institutional Money Continues to Flow In
14	2018-12-16	Mitchell Moos – Humor: Bitcoin SODLers Now Can Easily Sell the 'Bottom' with PayPal
15	2019-03-20	Mitchell Moos – Improving Bitcoin: Jack Dorsey Announces Open-Source Initiative Square Crypto
16	2018-05-14	Chelsea Roh – Bitcoin-Fueled Lamborghinis Kick Off NYC Consensus 2018
17	2019-10-28	Ali Martinez – Interest for blockchain skyrockets on WeChat and Baidu in China
18	2018-07-09	Joseph Young – Bitcoin Lightning Capacity Rises 68% in 1 Month Progress in Scaling and Micropayments
19	2018-06-29	Jonathan Kim – Wall Street Falls Behind: One Firm Trades Bitcoin for the Past Two Years
20	2019-07-24	Ali Martinez – Shares of Grayscale's Bitcoin Investment Trust cause investors to 'drop gold and everything else'

Table 66. Cryptoslate BTC - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2019-10-02	Jonnie Emsley – Bitcoin investors fearful according to Crypto Fear & Greed Index
2	2019-08-27	Jonnie Emsley – Craig Wright on court ruling: Kleiman could dump \$2 billion worth of Bitcoin
3	2018-01-05	Bill DeLisle – Would a Bitcoin Slump Actually Affect the Stock Market?
4	2019-08-01	Joseph Young – Bitcoin price surges to \$10400 in short-term reversal industry executives confident
5	2019-04-01	Mitchell Moos – Huge green candle pushes bitcoin from \$4200 to \$5000 in minutes BTC up 15% over past 24 hours
6	2018-11-03	Priyeshu Garg – Amsterdam Businesses Threatened with Grenades if Bitcoin Ransom Not Paid
7	2019-12-18	Priyeshu Garg – [Op-Ed] The curse of permabulls: Why you need to stop listening to Bitcoin maximalists
8	2019-12-25	Priyeshu Garg – Craig Wright's lawyers object to court motions with weakest arguments yet
9	2018-08-23	Jonathan Kim – Bitcoin ETF Rejections Under 'Review' by SEC
10	2019-10-20	News Desk – Bitcoin breaks downward monthly trend line shows 4% gains in past 24 hours
11	2019-09-07	Priyeshu Garg – Satoshi Nakamoto and Alexander Hamilton face off in epic rap battle
12	2018-08-12	Jonnie Emsley – Bitcoin Core Developer Revealed as Bitcoin Cash Bug Informant
13	2019-01-02	Priyeshu Garg – Hacker Group Threatens to Divulge Secrets About 9/11 Unless Paid Bitcoin Ransom
14	2018-11-24	Mitchell Moos – Bitcoin Obliterates \$4000 Support Level; Market Loses Another \$18 Billion Altcoins Reeling
15	2018-07-30	David Lee – Kim Kardashian Receives Her First Bitcoin "We've Moved Onto Bitcoin!"
16	2019-12-08	Ali Martinez – Understanding the Chilean social crisis and Bitcoin's potential impact on its people [INTERVIEW]
17	2019-07-31	Mitchell Moos – Court rules for Roger Ver in Craig Wright's Satoshi defamation lawsuit
18	2019-01-03	Mitchell Moos – Bitcoin and Bitcoin Cash Getting Gaslit by Craig Wright and Calvin Ayre?
19	2019-05-10	Priyeshu Garg – Craig Wright's evidence he's Satoshi in unredacted court documents is a 'clazy copy-paste job'
20	2019-12-24	Priyeshu Garg – Crypto Community petitions for a Bitcoin emoji for increased adoption

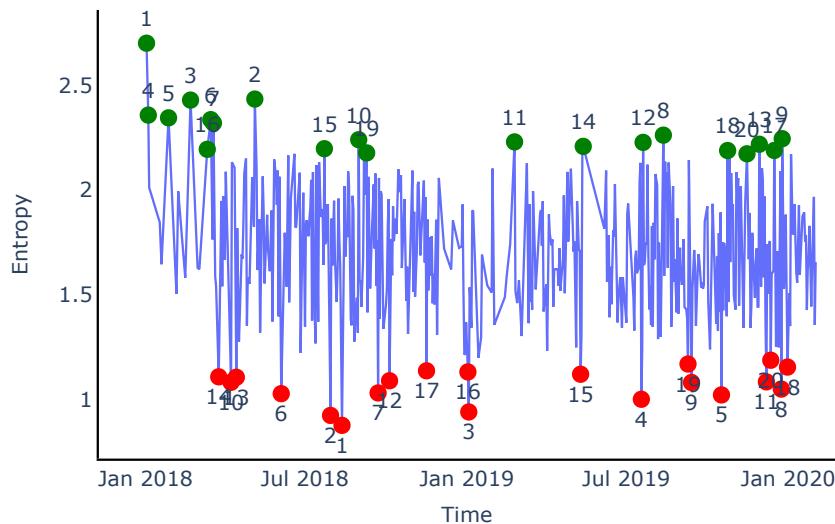
**Figure 33.** Top-20 articles that caused strongest and lowest sentiment - Cryptoslate BTC

Table 67. Cryptoslate BTC - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-02	Bill DeLisle – Bitcoin Rises After Peter Thiel Announces Big Investment
2	2018-05-05	Jacob Tuwiner – London Authorities Seize \$700000 in Bitcoin from Cybercriminal
3	2018-02-21	Sam Town – Japanese Exchange Glitch Allows Trader to Claim \$21 Trillion in Free Bitcoin
4	2018-01-04	Bill DeLisle – Bitcoin Futures Contracts Underwhelm In First Month of Trading
5	2018-01-27	Dylan Dedi – People Demand Retailers Embrace Crypto with Trending #PayWithCrypto Hashtag
6	2018-03-16	Bill DeLisle – Barclays Announces Partnership with Coinbase
7	2018-03-19	Sam Town – Bitcoin vs WoW Gold: Why Aren't Cryptos Treated Like In-Game Currencies?
8	2019-08-12	Priyeshu Garg – Researcher: Craig Wright refusing to move his coins in 2016 should have been a major red flag
9	2019-12-25	Priyeshu Garg – Craig Wright's lawyers object to court motions with weakest arguments yet
10	2018-08-31	Jonathan Kim – Satis Group Research Forecasts Bitcoin at \$144000 by 2028
11	2019-02-24	Mitchell Moos – Bitcoin Transactions Are Steadily Growing at January 2018 Levels
12	2019-07-20	Omar Faridi – Binance Research: most large Bitcoin and Ethereum investors hold stablecoins use cold wallets
13	2019-11-29	Ali Martinez – Bitcoin remains strong as \$160 million stolen from crypto exchanges in 2019
14	2019-05-13	Priyeshu Garg – Will the identity of bitcoin creator Satoshi Nakamoto be revealed on May 14th?
15	2018-07-23	Shaurya Malwa – Chinese Region Halts Cryptocurrency Mining Operations
16	2018-03-12	Bill DeLisle – Investors Look to Bitcoin to Judge When to Enter Crypto Markets
17	2019-12-16	Ali Martinez – Low volatility in BTC ETH and XRP could signal the next move
18	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
19	2018-09-09	Sam Town – Crypto Flirts With Stock Market: Robinhood Prepares to Go Public Coinbase CEO Hints Toward Possible IPO
20	2019-11-15	Ali Martinez – Bitcoin Ethereum and XRP prepare for a significant move

Table 68. Cryptoslate BTC - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-08-12	Jonnie Emsley – Bitcoin Core Developer Revealed as Bitcoin Cash Bug Informant
2	2018-07-30	David Lee – Kim Kardashian Receives Her First Bitcoin "We've Moved Onto Bitcoin!"
3	2019-01-03	Mitchell Moos – Bitcoin and Bitcoin Cash Getting Gaslit by Craig Wright and Calvin Ayre?
4	2019-07-18	Mitchell Moos – Chinese court upholds legality of Bitcoin ownership BTC protected by China's property laws
5	2019-10-17	Priyeshu Garg – Data shows autonomous coin Decred has a Power Law relationship with Bitcoin
6	2018-06-04	David Lee – Apple Co-Founder Steve Wozniak Joins Other Tech Luminaries in Rooting For Bitcoin as Global Currency
7	2018-09-22	Jonnie Emsley – Critical Bug Would Have Allowed Hackers to Create Bitcoin Detector Hints at Sabotage
8	2019-12-24	Priyeshu Garg – Crypto Community petitions for a Bitcoin emoji for increased adoption
9	2019-09-13	Priyeshu Garg – Trump could ban Bitcoin like e-cigarettes says prominent analyst
10	2018-04-08	Jonnie Emsley – Twitter Says Bye-Bye to @Bitcoin
11	2019-12-07	Priyeshu Garg – Craig Wright autographs Bitcoin whitepaper at Tsinghua University in China
12	2018-10-05	Jonnie Emsley – Fundstrat Report: Most Institutions Believe Bitcoin Has Bottomed
13	2018-04-14	Matthew North – Bitcoin Twitter Suspended Hijacked and Restored as Twitter Balances Free Speech in the Age of Crypto Disinformation
14	2018-03-25	Shiraz Jagati – Dutch Court Ruling States that Bitcoin has 'Transferable Value'
15	2019-05-10	Priyeshu Garg – Craig Wright's evidence he's Satoshi in unredacted court documents is a 'clazy copy-paste job'
16	2019-01-02	Priyeshu Garg – Hacker Group Threatens to Divulge Secrets About 9/11 Unless Paid Bitcoin Ransom
17	2018-11-16	Mitchell Moos – Ron Paul Twitter Survey: 50% of People Prefer Bitcoin as a Long-Term Investment
18	2019-12-31	Priyeshu Garg – Bitcoin's \$132bn market cap puts it above Turkey in terms of M1 money supply
19	2019-09-09	Priyeshu Garg – Bakkt launches institutional Bitcoin custody service with \$125 million in insurance
20	2019-12-12	Priyeshu Garg – BitMEX enables lower withdrawal fees with native SegWit support

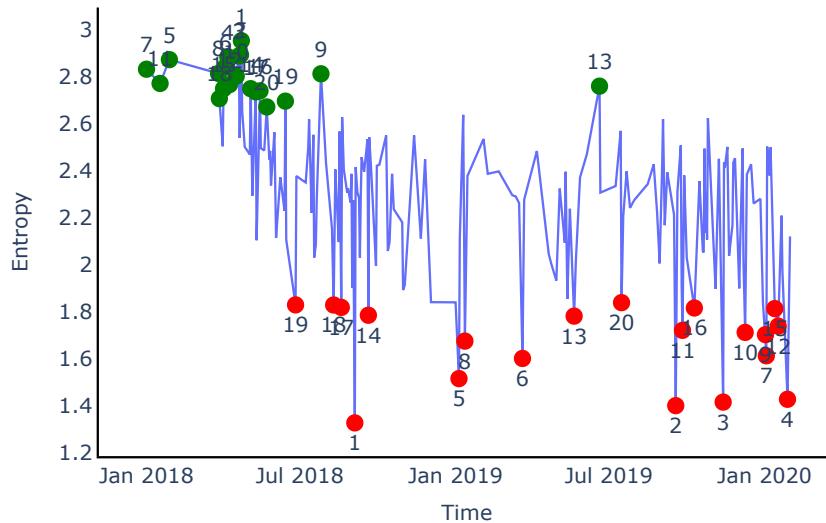


Figure 34. Top-20 articles that caused strongest and lowest negative sentiment - Cryptoslate ETH

Table 69. Cryptoslate ETH - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-04-23	Sam Town – From Russia With Love: Buterin Vs Pham in Twitter Throwdown Round 2
2	2018-04-22	Shiraz Jagati – Ethereum's Proof of Stake Protocol Under Review
3	2018-04-20	Sam Town – Crypto Trade Group Pressures SEC to Exempt Ethereum From Security Classification
4	2018-04-07	Sam Town – The Wrath of Vitalik: Crypto Savant Hulks Out Rampages on Twitter
5	2018-01-28	Chris Hall – How Radar Relay Is Revolutionizing Ethereum Token Trading
6	2018-04-04	Mitchell Moos – How Bitmain Will Ruin Ethereum Miners: Performance Analysis of the E3 ASIC
7	2018-01-01	Dylan Dedi – Ethereum's Raiden Network: An Off-Chain Solution to Scalable Payments
8	2018-03-27	Aliesha Duffin – OmiseGO and Vitalik Buterin Donating \$1 Million In Crypto To Refugees
9	2018-07-26	Shaurya Malwa – Cryptocurrency Hedge Funds are Shorting Ethereum Cite Scaling Issues
10	2018-04-17	Shiraz Jagati – NASA Initiates Independent Research on the Ethereum Blockchain
11	2018-01-17	Jacob Tuwiner – Introduction to Mining Cryptocurrencies: What You Need to Know
12	2018-04-09	Aliesha Duffin – Chile is Putting its Energy Data on Ethereum's Blockchain
13	2019-06-20	Mitchell Moos – MetLife the world's sixth-largest insurance company using Ethereum to transform life insurance
14	2018-05-04	Jonathan Kim – Korean Peace Treaty Made Permanent on Ethereum Blockchain
15	2018-04-02	Matthew North – World's 9th Largest Stock Exchange To Launch Cryptocurrency Brokerage
16	2018-05-15	Sam Town – Circle Raises \$110M to Create 'USDC' Ethereum-Compatible Stablecoin
17	2018-05-10	Bill DeLisle – Ethereum Founder Provides Updates on the Progress of Casper After Community Development Conference
18	2018-03-28	Mitchell Moos – Why Bitmain's Ethereum ASICs Will Never Replace GPUs
19	2018-06-14	Sam Town – Crypto Market Bounces Back: SEC Declares Bitcoin and Ethereum are Not Securities
20	2018-05-23	Aliesha Duffin – From Bait to Plate on Ethereum's Blockchain

Table 70. Cryptoslate ETH - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-09-04	Joseph Young – Buterin Debunks Argument Made by Expert That ETH Not Ethereum Will Hit Zero
2	2019-09-18	Priyeshu Garg – Ethereum ProgPOW author uninvited from ETC Summit due to Craig Wright association
3	2019-11-13	Priyeshu Garg – Hackathon winner Sheetcoin offers an Ethereum wallet on Google Sheets
4	2020-01-28	Reuben Jackson – Ethereum broadens its reach after Syscoin builds it a bridge
5	2019-01-05	Mitchell Moos – Ethereum TRON Iota Lead in Performance Adjusted for Risk by Sharpe Ratio Bitcoin Underperforms
6	2019-03-21	Mitchell Moos – MakerDAO Voters Support Raising Ethereum-backed Loan Interest Rates to 7.5 Percent
7	2020-01-03	Ali Martinez – Ethereum pushes back difficulty bomb while traders may be turning bullish
8	2019-01-12	Priyeshu Garg – ConsenSys Founder Joe Lubin Says The Next Killer App (Ethereum) is Already Here
9	2020-01-02	Omar Faridi – Ethereum network survives malicious attack but raises serious security concerns
10	2019-12-09	Ali Martinez – Ethereum could soon enable thousands of transactions per second
11	2019-09-26	Mitchell Moos – New Ethereum ASIC dominates GPU mining performance
12	2020-01-17	Cole Petersen – This technical formation could mean Ethereum is in for massive short-term upside
13	2019-05-21	Mitchell Moos – The curious case of Ethereum's missing warrant canary
14	2018-09-20	Cole Kennelly – Top 5 Ethereum Decentralized Applications (dApps) by Daily Active Users - Sept. 20
15	2020-01-13	Ali Martinez – Bitcoin Ethereum and XRP sit at a make-or-break point
16	2019-10-10	Priyeshu Garg – Community still believes in Ethereum 2.0 despite scaling challenges
17	2018-08-19	Shaurya Malwa – Report: Nearly \$2.5 Billion Paid Annually to Ethereum Miners ETH Issuance Woes Continue
18	2018-08-10	Jonnie Emsley – Microsoft Unveils New Ethereum Blockchain-as-a-Service
19	2018-06-26	Jaycen Horton – What Crypto Investors Need to Know About Ethereum ERC777 - the New Advanced Token Standard
20	2019-07-16	Priyeshu Garg – Vitalik Buterin proposes using Bitcoin Cash as Ethereum's data layer

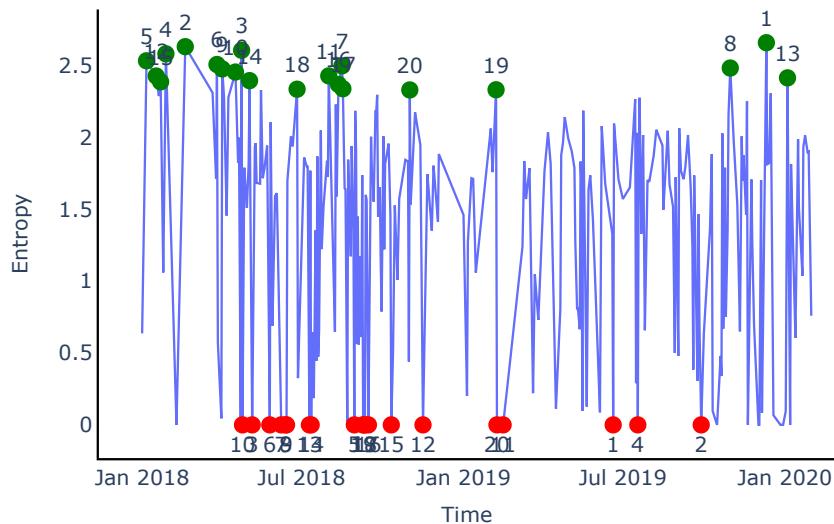
**Figure 35.** Top-20 articles that caused strongest and lowest positive sentiment - Cryptoslate ETH

Table 71. Cryptoslate ETH - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-12-11	Jonnie Emsley – Ethereum locked in DeFi hits all-time high total deposits up 22400 percent in two years
2	2018-02-19	Ali Raza – ETHGlobal to Sponsor Ethereum Hackathons All Over the World
3	2018-04-24	Shiraz Jagati – MyEtherWallet Compromised as Hackers Make Their Way with over \$150K Worth of Digital Currency
4	2018-01-28	Chris Hall – How Radar Relay Is Revolutionizing Ethereum Token Trading
5	2018-01-06	Bill DeLisle – Ethereum Suprases \$1000 On Strong Market and Launch of Casper Testnet
6	2018-03-27	Aliesha Duffin – OmiseGO and Vitalik Buterin Donating \$1 Million In Crypto To Refugees
7	2018-08-16	Jonathan Kim – Stably Launches StableUSD on Ethereum Mainnet
8	2019-10-31	Priyeshu Garg – Users of decentralized exchange will be able to vote on the next protocol upgrade
9	2018-04-02	Matthew North – World's 9th Largest Stock Exchange To Launch Cryptocurrency Brokerage
10	2018-04-17	Shiraz Jagati – NASA Initiates Independent Research on the Ethereum Blockchain
11	2018-08-01	Jonathan Kim – Ethereum Founder Vitalik Buterin: "We're at the Tail End of a Crypto Bubble"
12	2018-01-17	Bill DeLisle – Examining the True Decentralization of Bitcoin and Ethereum
13	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
14	2018-05-03	Sam Town – Reddit Co-founder Makes Wild Prediction: \$15000 Ethereum Price by End of 2018
15	2018-01-22	Dylan Dedi – Exploring the Best Ethereum Mobile dApp Browsers
16	2018-08-12	Shaurya Malwa – IOHK Calls Out Ethereum's Casper Protocol In Favor of Own "Ouroboros"
17	2018-08-17	Shaurya Malwa – Vitalik Buterin Goes on "Tweet Storm" About Ethereum's Casper
18	2018-06-26	Jaycen Horton – What Crypto Investors Need to Know About Ethereum ERC777 - the New Advanced Token Standard
19	2019-02-07	Darryn Pollock – Opera Launches In-Browser Ethereum Buys for Scandinavian Customers
20	2018-11-01	Priyeshu Garg – Early-Access Launch of USD-Pegged Cryptocurrency StableUSD Announced by Stably

Table 72. Cryptoslate ETH - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-06-20	Mitchell Moos – MetLife the world's sixth-largest insurance company using Ethereum to transform life insurance
2	2019-09-28	Priyeshu Garg – Venezuela could hold BTC and ETH in its international reserves
3	2018-05-06	Sam Town – The Fate of Ethereum: ETH Pushes Toward \$800 as Regulatory Announcement Looms
4	2019-07-18	Priyeshu Garg – Ethereum whale accumulates another 20000 ETH in massive buy wall
5	2018-08-30	Jonathan Kim – Cboe Global Markets Hints at Launching Ethereum Futures
6	2018-05-26	Sam Town – Vitalik Buterin Responds to Ethereum Blockchain Size Concerns
7	2018-06-08	Jonnie Emsley – Parity Admits to "Critical" Vulnerability in Testnet That Could Corrupt Ethereum
8	2018-06-13	Sam Town – Hackers Scoop \$20 Million in ETH From Exposed Ethereum Nodes
9	2018-06-14	Sam Town – Crypto Market Bounces Back: SEC Declares Bitcoin and Ethereum are Not Securities
10	2018-04-25	Sam Town – BatchOverflow Exploit Creates Trillions of Ethereum Tokens Major Exchanges Halt ERC20 Deposits
11	2019-02-15	Darryn Pollock – Nasdaq Will Provide Real-Time Bitcoin and Ethereum Index Information
12	2018-11-16	Priyeshu Garg – XRP Takes over Ethereum to Become the Largest Altcoin by Market Cap
13	2018-07-10	Jacob Tuwiner – Google Co-Founder Reveals He is Mining Ethereum with Son
14	2018-07-12	Jonathan Kim – MyEtherWallet Hola VPN Compromised User Accounts Exposed
15	2018-10-11	Shaurya Malwa – SpankChain Smart Contract Compromised Hackers Take \$38000 in Ethereum (ETH)
16	2018-09-15	Joseph Young – Ethereum Surges 33% Within 4 Days Will ETH be Able to Sustain Momentum?
17	2018-09-11	Shaurya Malwa – ICO Funding Falls to Lowest Point in a Year Due to Crypto Bear Market
18	2018-09-10	Sam Town – Crypto Market Stabilizes: Bitcoin Ethereum Some Alts Back In Green
19	2018-09-09	Sam Town – Vitalik Buterin Proclaims an End to Explosive Growth as ETH Values Plummet: How Will Ethereum Recover?
20	2019-02-08	Darryn Pollock – Analyzing Vitalik Buterin's Statement About Cryptos that are 'Centralized Piles of Trash'

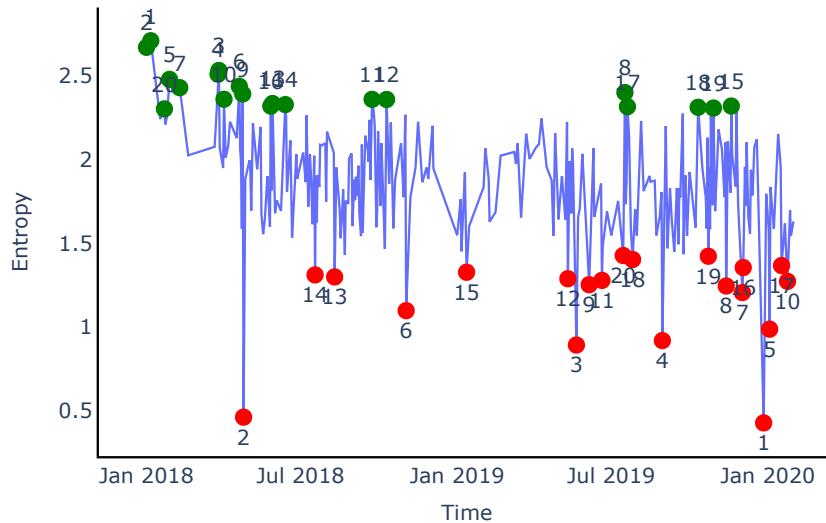


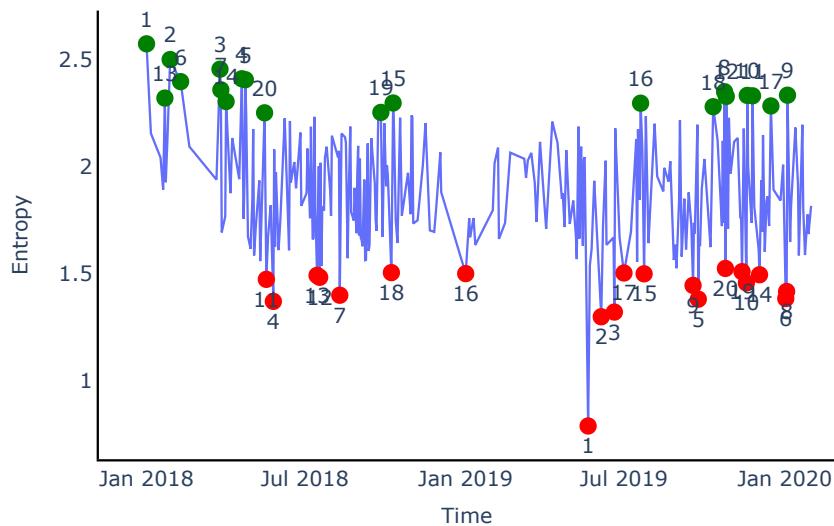
Figure 36. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptoslate ETH

Table 73. Cryptoslate ETH - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-06	Bill DeLisle – Ethereum Suprases \$1000 On Strong Market and Launch of Casper Testnet
2	2018-01-01	Dylan Dedi – Ethereum’s Raiden Network: An Off-Chain Solution to Scalable Payments
3	2018-03-27	Aliesha Duffin – OmiseGO and Vitalik Buterin Donating \$1 Million In Crypto To Refugees
4	2018-03-26	News Desk – Coinbase Announces ERC20 Token Support - What Will This Mean For Crypto?
5	2018-01-28	Chris Hall – How Radar Relay Is Revolutionizing Ethereum Token Trading
6	2018-04-20	Sam Town – Crypto Trade Group Pressures SEC to Exempt Ethereum From Security Classification
7	2018-02-09	Dylan Dedi – Exploring MyEtherWallet’s Strange Transition to MyCrypto
8	2019-07-17	Omar Faridi – Institutional demand for Bitcoin and Ethereum causes Grayscale AUM to nearly triple reduces exposure to XRP
9	2018-04-24	Shiraz Jagati – MyEtherWallet Compromised as Hackers Make Their Way with over \$150K Worth of Digital Currency
10	2018-04-02	Matthew North – World’s 9th Largest Stock Exchange To Launch Cryptocurrency Brokerage
11	2018-09-23	Cole Kennelly – Brazil’s Biggest Brokerage Goes Big on Bitcoin
12	2018-10-10	John Bogna – Ethereum EOS DApp Daily Active Users (DAU) Hits “All-Time High”
13	2018-05-29	Jonnie Emsley – Ethereum Founder Vitalik Buterin Shifts Stance on Privacy
14	2018-06-13	Sam Town – Hackers Scoop \$20 Million in ETH From Exposed Ethereum Nodes
15	2019-11-19	News Desk – DeversiFi CEO talks building on Ethereum in 2015 vs now benefits of decentralized exchange and shares customer stories
16	2018-05-27	Sam Town – Five Reasons to Be Bullish About Bitcoin Ethereum and the Future of Crypto
17	2019-07-20	Omar Faridi – Binance Research: most large Bitcoin and Ethereum investors hold stablecoins use cold wallets
18	2019-10-11	Jonnie Emsley – CTFC head: Ethereum is a commodity anticipates launch of ETH futures
19	2019-10-29	Priyeshu Garg – MakerDAO whale with 94% voting power reduces Dai stability fee by 4%
20	2018-01-22	Dylan Dedi – Exploring the Best Ethereum Mobile dApp Browsers

Table 74. Cryptoslate ETH - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2019-12-27	Priyeshu Garg – Ethereum researcher Virgil Griffith denied bail on charges of conspiring with North Korea
2	2018-04-25	Sam Town – BatchOverflow Exploit Creates Trillions of Ethereum Tokens Major Exchanges Halt ERC20 Deposits
3	2019-05-21	Mitchell Moos – The curious case of Ethereum's missing warrant canary
4	2019-08-30	Ali Martinez – Hyperledger welcomes its first public blockchain – Ethereum
5	2020-01-03	Ali Martinez – Ethereum pushes back difficulty bomb while traders may be turning bullish
6	2018-11-02	Priyeshu Garg – Ethereum Remains Monopolistic Platform for ICOs; Stellar NEO Follow Lead
7	2019-12-02	Ali Martinez – Ethereum's North Korean nightmare: Vitalik Buterin pledges to help free Virgil Griffith
8	2019-11-13	Priyeshu Garg – Hackathon winner Sheetcoin offers an Ethereum wallet on Google Sheets
9	2019-06-05	Priyeshu Garg – Samaritan developer returns \$500000 worth of Ethereum to rightful owner
10	2020-01-24	Cole Petersen – Ethereum could be primed for a move to over \$200 despite ongoing selloff
11	2019-06-20	Mitchell Moos – MetLife the world's sixth-largest insurance company using Ethereum to transform life insurance
12	2019-05-11	Ali Martinez – Ethereum is breaking out following bitcoin's bullish momentum
13	2018-08-10	Jonnie Emsley – Microsoft Unveils New Ethereum Blockchain-as-a-Service
14	2018-07-18	Jonnie Emsley – Vitalik Buterin Estimates Ethereum Spam Transaction Fees at \$15 million
15	2019-01-12	Priyeshu Garg – ConsenSys Founder Joe Lubin Says The Next Killer App (Ethereum) is Already Here
16	2019-12-03	Priyeshu Garg – Ethereum Researcher to be released from jail after getting new legal representation
17	2020-01-17	Cole Petersen – This technical formation could mean Ethereum is in for massive short-term upside
18	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move
19	2019-10-23	Joseph Young – Ethereum plummets 6% after Bitcoin falls overnight: what's causing the drop?
20	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?

**Figure 37.** Top-20 articles that caused strongest and lowest sentiment - Cryptoslate ETH

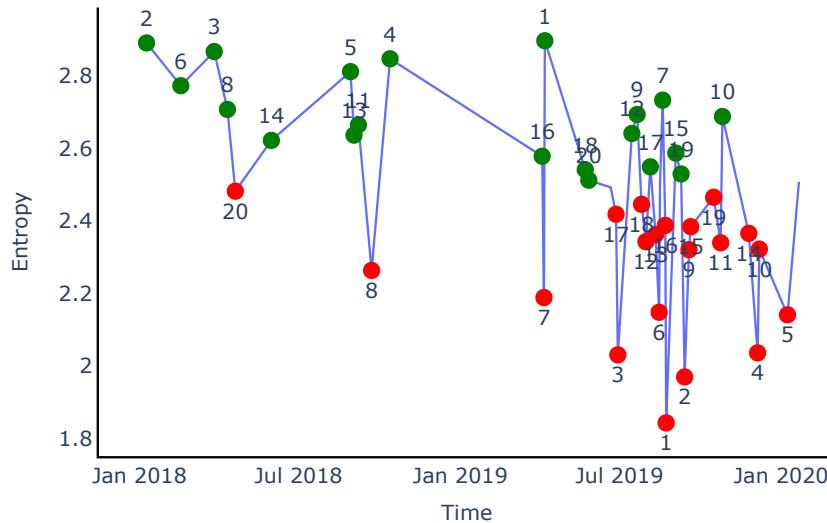
5 INTERPRETATION OF SENTIMENT INDICES

Table 75. Cryptoslate ETH - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-01	Dylan Dedi – Ethereum’s Raiden Network: An Off-Chain Solution to Scalable Payments
2	2018-01-28	Chris Hall – How Radar Relay Is Revolutionizing Ethereum Token Trading
3	2018-03-26	News Desk – Coinbase Announces ERC20 Token Support - What Will This Mean For Crypto?
4	2018-04-20	Sam Town – Crypto Trade Group Pressures SEC to Exempt Ethereum From Security Classification
5	2018-04-24	Shiraz Jagati – MyEtherWallet Compromised as Hackers Make Their Way with over \$150K Worth of Digital Currency
6	2018-02-09	Dylan Dedi – Exploring MyEtherWallet’s Strange Transition to MyCrypto
7	2018-03-27	Aliesha Duffin – OmiseGO and Vitalik Buterin Donating \$1 Million In Crypto To Refugees
8	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
9	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
10	2019-11-19	News Desk – Deversifi CEO talks building on Ethereum in 2015 vs now benefits of decentralized exchange and shares customer stories
11	2019-11-25	Ali Martinez – Are Ethereum XRP and Litecoin on the road to recovery?
12	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
13	2018-01-22	Dylan Dedi – Exploring the Best Ethereum Mobile dApp Browsers
14	2018-04-02	Matthew North – World’s 9th Largest Stock Exchange To Launch Cryptocurrency Brokerage
15	2018-10-10	John Bohn – Ethereum EOS DApp Daily Active Users (DAU) Hits “All-Time High”
16	2019-07-20	Omar Faridi – Binance Research: most large Bitcoin and Ethereum investors hold stablecoins use cold wallets
17	2019-12-16	Ali Martinez – Low volatility in BTC ETH and XRP could signal the next move
18	2019-10-11	Jonnie Emsley – CTFC head: Ethereum is a commodity anticipates launch of ETH futures
19	2018-09-26	Shaurya Malwa – Wanchain (WAN) Support Added to Binance Trust Wallet
20	2018-05-16	Sam Town – Ethereum Founder Vitalik Buterin Helps Daniel Larimer Code Says EOS “Not Actually Safe”

Table 76. Cryptoslate ETH - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2019-05-21	Mitchell Moos – The curious case of Ethereum’s missing warrant canary
2	2019-06-05	Priyeshu Garg – Samaritan developer returns \$500000 worth of Ethereum to rightful owner
3	2019-06-20	Mitchell Moos – MetLife the world’s sixth-largest insurance company using Ethereum to transform life insurance
4	2018-05-26	Sam Town – Vitalik Buterin Responds to Ethereum Blockchain Size Concerns
5	2019-09-24	Mitchell Moos – Ethereum miners increase network capacity by 20% in response to congestion
6	2020-01-02	Omar Faridi – Ethereum network survives malicious attack but raises serious security concerns
7	2018-08-10	Jonnie Emsley – Microsoft Unveils New Ethereum Blockchain-as-a-Service
8	2020-01-03	Ali Martinez – Ethereum pushes back difficulty bomb while traders may be turning bullish
9	2019-09-18	Priyeshu Garg – Ethereum ProgPOW author uninvited from ETC Summit due to Craig Wright association
10	2019-11-18	Joseph Young – Altcoins retrace to 2017 levels: why it’s a critical moment for Ethereum XRP et al.
11	2018-05-18	Sam Town – Steve Wozniak Compares Ethereum to Early Apple
12	2018-07-18	Jonnie Emsley – Vitalik Buterin Estimates Ethereum Spam Transaction Fees at \$15 million
13	2018-07-15	Sam Town – Ethereum Network Under Assault: Gas Price Manipulation May Indicate Covert EOS Attack [INTERVIEW]
14	2019-12-03	Priyeshu Garg – Ethereum Researcher to be released from jail after getting new legal representation
15	2019-07-24	Omar Faridi – Ethereum improvement proposal 2025 increases block reward community opposed to maintain ETH as store-of-value
16	2019-01-01	Mitchell Moos – Ethereum Regains Momentum Poised to Overtake Ripple by Market Capitalization
17	2019-07-01	Priyeshu Garg – Ethereum Foundation announces spec freeze for ETH 2.0
18	2018-10-08	Jonnie Emsley – Ethereum to See Casper and Plasma With or Without Vitalik
19	2019-11-13	Priyeshu Garg – Hackathon winner Sheetcoin offers an Ethereum wallet on Google Sheets
20	2019-10-25	Priyeshu Garg – Prominent investor believes Ethereum’s monetary policy is underrated

**Figure 38.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptoslate LTC**Table 77.** Cryptoslate LTC - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-04-07	Priyeshu Garg – YTD performance report: Bitcoin Ethereum XRP Litecoin and Bitcoin Cash
2	2018-01-09	Matt Breen – Litecoin's Soft Fork - Charlie Lee's Plan for a 'Fee Market'
3	2018-03-27	Aliesha Duffin – Litecoin Price Dips After Litepay Announcement
4	2018-10-13	John Bogna – Gemini Announces Litecoin Availability With NY State Approval
5	2018-08-29	Jonathan Kim – Roger Ver and Charlie Lee Discuss Bitcoin Bitcoin Cash and Litecoin
6	2018-02-17	Sam Town – Litecoin Rallies Over 50% Ahead of Litepay Announcement Fork Rumors
7	2019-08-19	Mitchell Moos – Hostile mining attacks on minority hash power coins - why Litecoin is more secure than Bitcoin Cash and Bitcoin SV
8	2018-04-11	Sam Town – LTC Recovers as Litecoin Smart Contracts Set to Go Live
9	2019-07-21	Mitchell Moos – Research finds Bitcoin and Litecoin halvings do not impact price
10	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
11	2018-09-07	Jonathan Kim – Research: Nearly Half of Millennials Prefer Crypto Over Fiat
12	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?
13	2018-09-02	Sam Town – Cryptocurrency Adoption Accelerates Litecoin Creator Calls for End to Fiat
14	2018-05-31	Sam Town – Litecoin Founder Charlie Lee: LTC Network Extremely Secure Mining Healthy
15	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
16	2019-04-04	Mitchell Moos – Litecoin follows in bitcoin's wake touches \$100
17	2019-08-05	Ali Martinez – The Litecoin halving has concluded and LTC is up 9 percent
18	2019-05-23	Ali Martinez – Top 5 forecast: Bitcoin Ethereum XRP Bitcoin Cash and Litecoin technical analysis
19	2019-09-09	Mitchell Moos – Charlie Lee: Bitcoin and Litecoin are the best forms of money ever seen [INTERVIEW]
20	2019-05-27	Omar Faridi – Litecoin's onchain metrics show growing interest

Table 78. Cryptoslate LTC - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-08-23	Priyeshu Garg – Halving reduced Litecoin's mining hash rate by almost 30%
2	2019-09-13	Priyeshu Garg – On-chain data shows Litecoin is healthy potential for LTC/BTC rebound
3	2019-06-29	Priyeshu Garg – Litecoin and DigiByte founders cryptographically proved they created their blockchains why can't Craig Wright?
4	2019-12-05	Priyeshu Garg – Analyst: Litecoin not in danger of a 51% attack despite bottomed hashrate
5	2020-01-08	Cole Petersen – Data shows Litecoin may be ready to go parabolic as crypto markets incur massive momentum
6	2019-08-15	Priyeshu Garg – Litecoin users on Binance fell victim to a dusting attack's how to prevent it from happening to you
7	2019-04-06	Mitchell Moos – Analyzing Charlie Lee's legendary Litecoin price predictions
8	2018-09-22	John Bogna – Litecoin Creator Charlie Lee Debunks Negative Rumors Surrounding LTC
9	2019-09-18	Mitchell Moos – Litecoin will have succeeded when it doesn't need Charlie Lee [INTERVIEW]
10	2019-12-07	Ali Martinez – Ethereum XRP and Litecoin remain stagnant; where will they head next?
11	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
12	2019-07-31	Ali Martinez – As Litecoin's halving approaches will LTC's price surge correct or consolidate?
13	2019-08-11	Mitchell Moos – Charlie Lee refutes that Litecoin is being abandoned - active development continues
14	2019-11-25	Ali Martinez – Are Ethereum XRP and Litecoin on the road to recovery?
15	2019-09-20	Ali Martinez – Ethereum XRP and Litecoin stage major recoveries indicating the start of a new altseason
16	2019-08-22	Ali Martinez – Three drug lords have their Bitcoin and Litecoin addresses blacklisted by US Treasury
17	2019-06-27	Ali Martinez – Litecoin halving approaching and price already showing signs of exhaustion
18	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move
19	2019-10-16	Ali Martinez – Bitcoin Ethereum and Litecoin sink as buying pressure fades
20	2018-04-20	Sam Town – Litecoin Lighting Up Approaching \$200: LTC News Roundup

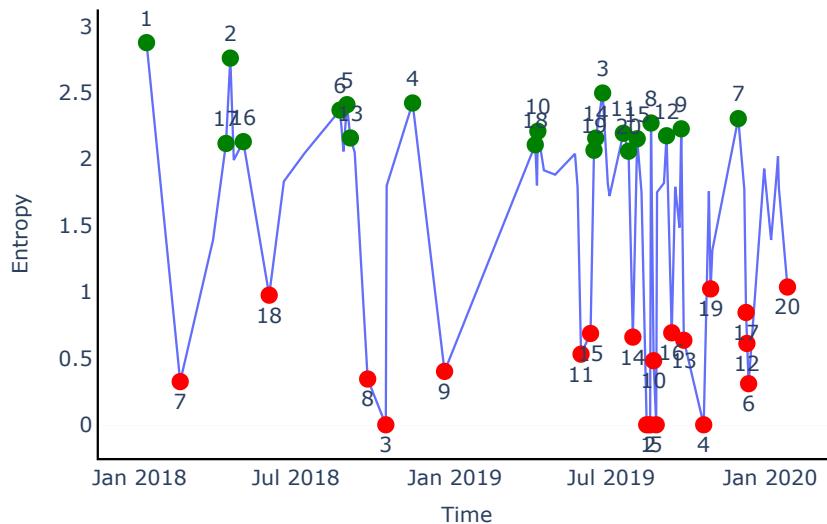
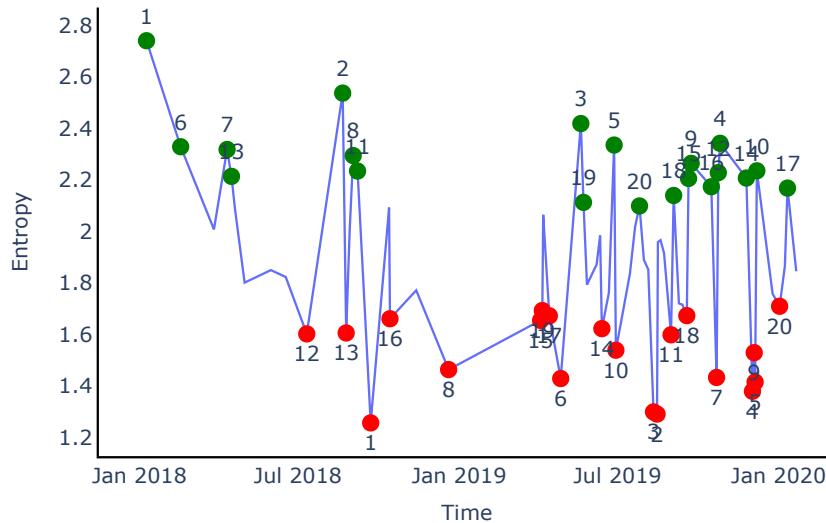
**Figure 39.** Top-20 articles that caused strongest and lowest positive sentiment - Cryptoslate LTC

Table 79. Cryptoslate LTC - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-01-09	Matt Breen – Litecoin’s Soft Fork - Charlie Lee’s Plan for a “Fee Market”
2	2018-04-16	Matthew North – You Can Now Run a Litecoin Lightning Network Node On Your Mac
3	2019-06-21	Ali Martinez – Top 3 altcoins: Ethereum XRP and Litecoin technical analysis
4	2018-11-13	John Bogna – \$62 Million Litecoin Transaction Sent for Fifty Cents: The Potential of Crypto Transactions
5	2018-08-29	Jonathan Kim – Roger Ver and Charlie Lee Discuss Bitcoin Bitcoin Cash and Litecoin
6	2018-08-21	Jonnie Emsley – eToro CEO Says Correction is Healthy Platform Bets on Litecoin
7	2019-11-25	Ali Martinez – Are Ethereum XRP and Litecoin on the road to recovery?
8	2019-08-16	Ali Martinez – What’s next for Ethereum XRP and Litecoin after the recent plunge ?
9	2019-09-20	Ali Martinez – Ethereum XRP and Litecoin stage major recoveries indicating the start of a new altseason
10	2019-04-07	Priyeshu Garg – YTD performance report: Bitcoin Ethereum XRP Litecoin and Bitcoin Cash
11	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?
12	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC
13	2018-09-02	Sam Town – Cryptocurrency Adoption Accelerates Litecoin Creator Calls for End to Fiat
14	2019-06-13	Ali Martinez – As the halving approaches Litecoin could plunge like it did in 2015
15	2019-07-31	Ali Martinez – As Litecoin’s halving approaches will LTC’s price surge correct or consolidate?
16	2018-05-01	Jonathan Kim – Litecoin Payments Slowly Moving Into the Mainstream
17	2018-04-11	Sam Town – LTC Recovers as Litecoin Smart Contracts Set to Go Live
18	2019-04-04	Mitchell Moos – Litecoin follows in bitcoin’s wake touches \$100
19	2019-06-11	Ali Martinez – Could Litecoin overtake XRP before the halving?
20	2019-07-21	Mitchell Moos – Research finds Bitcoin and Litecoin halvings do not impact price

Table 80. Cryptoslate LTC - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-08-11	Mitchell Moos – Charlie Lee refutes that Litecoin is being abandoned - active development continues
2	2019-08-15	Priyeshu Garg – Litecoin users on Binance fell victim to a dusting attack - here’s how to prevent it from happening to you
3	2018-10-13	John Bogna – Gemini Announces Litecoin Availability With NY State Approval
4	2019-10-16	Ali Martinez – Bitcoin Ethereum and Litecoin sink as buying pressure fades
5	2019-08-22	Ali Martinez – Three drug lords have their Bitcoin and Litecoin addresses blacklisted by US Treasury
6	2019-12-07	Ali Martinez – Ethereum XRP and Litecoin remain stagnant; where will they head next?
7	2018-02-17	Sam Town – Litecoin Rallies Over 50% Ahead of Litepay Announcement Fork Rumors
8	2018-09-22	John Bogna – Litecoin Creator Charlie Lee Debunks Negative Rumors Surrounding LTC
9	2018-12-20	Mitchell Moos – The Unflappening Bitcoin Cash Leaves Litecoin to Roost
10	2019-08-19	Mitchell Moos – Hostile mining attacks on minority hash power coins - why Litecoin is more secure than Bitcoin Cash and Bitcoin SV
11	2019-05-27	Omar Faridi – Litecoin’s onchain metrics show growing interest
12	2019-12-05	Priyeshu Garg – Analyst: Litecoin not in danger of a 51% attack despite bottomed hashrate
13	2019-09-23	Ali Martinez – Ethereum XRP and Litecoin prices show indecision in the market
14	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move
15	2019-06-07	Priyeshu Garg – US 2020 presidential candidate Andrew Yang meets with Litecoin founder
16	2019-09-09	Mitchell Moos – Charlie Lee: Bitcoin and Litecoin are the best forms of money ever seen [INTERVIEW]
17	2019-12-04	Jonnie Emsley – Litecoin Foundation launches crowdfunding campaign to develop confidential transactions for LTC
18	2018-05-31	Sam Town – Litecoin Founder Charlie Lee: LTC Network Extremely Secure Mining Healthy
19	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
20	2020-01-21	Ali Martinez – Ethereum XRP and Litecoin could be bound for a steeper decline

**Figure 40.** Top-20 articles that caused strongest and lowest neutral sentiment - Cryptoslate LTC**Table 81.** Cryptoslate LTC - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-09	Matt Breen – Litecoin’s Soft Fork - Charlie Lee’s Plan for a “Fee Market”
2	2018-08-21	Jonnie Emsley – eToro CEO Says Correction is Healthy Platform Bets on Litecoin
3	2019-05-20	Priyeshu Garg – Send Bitcoin and Litecoin transactions over WhatsApp
4	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
5	2019-06-27	Ali Martinez – Litecoin halving approaching and price already showing signs of exhaustion
6	2018-02-17	Sam Town – Litecoin Rallies Over 50% Ahead of Litepay Announcement Fork Rumors
7	2018-04-11	Sam Town – LTC Recovers as Litecoin Smart Contracts Set to Go Live
8	2018-09-02	Sam Town – Cryptocurrency Adoption Accelerates Litecoin Creator Calls for End to Fiat
9	2019-09-23	Ali Martinez – Ethereum XRP and Litecoin prices show indecision in the market
10	2019-12-07	Ali Martinez – Ethereum XRP and Litecoin remain stagnant; where will they head next?
11	2018-09-07	Jonathan Kim – Research: Nearly Half of Millennials Prefer Crypto Over Fiat
12	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
13	2018-04-16	Matthew North – You Can Now Run a Litecoin Lightning Network Node On Your Mac
14	2019-11-25	Ali Martinez – Are Ethereum XRP and Litecoin on the road to recovery?
15	2019-09-20	Ali Martinez – Ethereum XRP and Litecoin stage major recoveries indicating the start of a new altseason
16	2019-10-16	Ali Martinez – Bitcoin Ethereum and Litecoin sink as buying pressure fades
17	2020-01-11	Cole Petersen – Crypto markets rally as Bitcoin flashes bullish signs; is altseason upon us?
18	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
19	2019-05-23	Ali Martinez – Top 5 forecast: Bitcoin Ethereum XRP Bitcoin Cash and Litecoin technical analysis
20	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move

Table 82. Cryptoslate LTC - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-09-22	John Bogna – Litecoin Creator Charlie Lee Debunks Negative Rumors Surrounding LTC
2	2019-08-15	Priyeshu Garg – Litecoin users on Binance fell victim to a dusting attack - here's how to prevent it from happening to you
3	2019-08-11	Mitchell Moos – Charlie Lee refutes that Litecoin is being abandoned - active development continues
4	2019-12-02	Jonnie Emsley – Grin developer: Litecoin closer to gaining privacy features with MimbleWimble
5	2019-12-05	Priyeshu Garg – Analyst: Litecoin not in danger of a 51% attack despite bottomed hashrate
6	2019-04-27	Ali Martinez – Upcoming block reward halving could give Litecoin a boost
7	2019-10-22	Ali Martinez – Cornerstone Global Management adds Litecoin to its crypto pay and pension plan program
8	2018-12-20	Mitchell Moos – The Unflapping Bitcoin Cash Leaves Litecoin to Roost
9	2019-12-04	Jonnie Emsley – Litecoin Foundation launches crowdfunding campaign to develop confidential transactions for LTC
10	2019-06-29	Priyeshu Garg – Litecoin and DigiByte founders cryptographically proved they created their blockchains why can't Craig Wright?
11	2019-08-31	Priyeshu Garg – Analyst: unlike Litecoin Bitcoin's halving will have a significant effect on its price
12	2018-07-11	Jacob Tuwiner – Bringing Crypto to the Masses: Litecoin and TokenPay Form Strategic Partnership
13	2018-08-25	Trevor Ballanger – Litecoin Foundation Reveals Additional Details of First Annual Summit
14	2019-06-13	Ali Martinez – As the halving approaches Litecoin could plunge like it did in 2015
15	2019-04-04	Mitchell Moos – Litecoin follows in bitcoin's wake touches \$100
16	2018-10-14	Cole Kennelly – Happy Birthday Litecoin! LTC Turns 7-Years-Old
17	2019-04-14	Joseph Young – Litecoin (LTC) hash rate hits record high: is it a crucial sign of confidence?
18	2019-09-18	Mitchell Moos – Litecoin will have succeeded when it doesn't need Charlie Lee [INTERVIEW]
19	2019-04-06	Mitchell Moos – Analyzing Charlie Lee's legendary Litecoin price predictions
20	2020-01-02	Jonnie Emsley – Development has started on Litecoin privacy features but crowdfund still needs \$57000 in donations

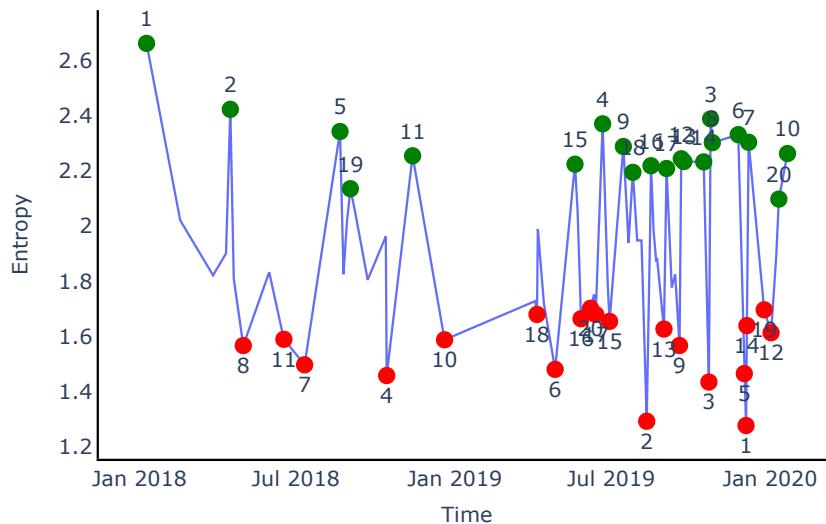
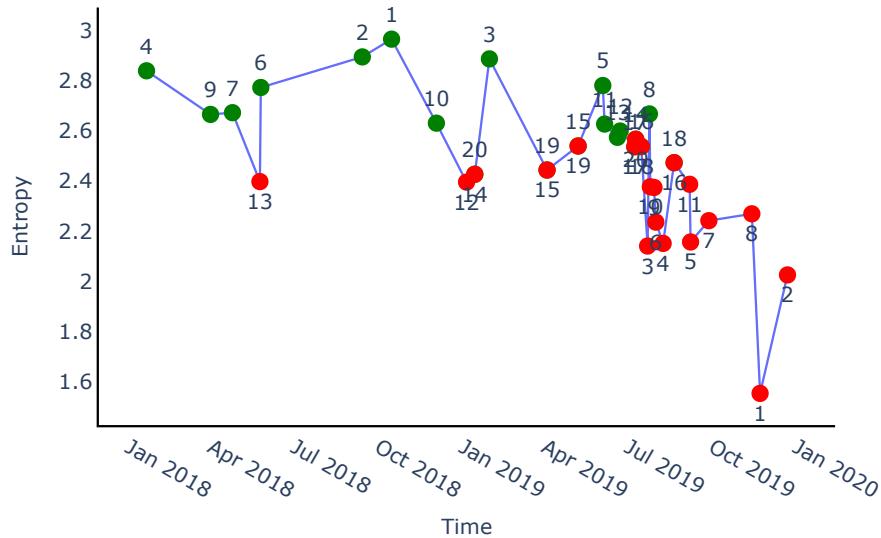
**Figure 41.** Top-20 articles that caused strongest and lowest sentiment - Cryptoslate LTC

Table 83. Cryptoslate LTC - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-09	Matt Breen – Litecoin’s Soft Fork - Charlie Lee’s Plan for a “Fee Market”
2	2018-04-16	Matthew North – You Can Now Run a Litecoin Lightning Network Node On Your Mac
3	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
4	2019-06-21	Ali Martinez – Top 3 altcoins: Ethereum XRP and Litecoin technical analysis
5	2018-08-21	Jonnie Emsley – eToro CEO Says Correction is Healthy Platform Bets on Litecoin
6	2019-11-25	Ali Martinez – Are Ethereum XRP and Litecoin on the road to recovery?
7	2019-12-07	Ali Martinez – Ethereum XRP and Litecoin remain stagnant; where will they head next?
8	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
9	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?
10	2020-01-21	Ali Martinez – Ethereum XRP and Litecoin could be bound for a steeper decline
11	2018-11-13	John Bogna – \$62 Million Litecoin Transaction Sent for Fifty Cents: The Potential of Crypto Transactions
12	2019-09-20	Ali Martinez – Ethereum XRP and Litecoin stage major recoveries indicating the start of a new altseason
13	2019-09-23	Ali Martinez – Ethereum XRP and Litecoin prices show indecision in the market
14	2019-10-16	Ali Martinez – Bitcoin Ethereum and Litecoin sink as buying pressure fades
15	2019-05-20	Priyeshu Garg – Send Bitcoin and Litecoin transactions over WhatsApp
16	2019-08-16	Ali Martinez – What’s next for Ethereum XRP and Litecoin after the recent plunge ?
17	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
18	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move
19	2018-09-02	Sam Town – Cryptocurrency Adoption Accelerates Litecoin Creator Calls for End to Fiat
20	2020-01-11	Cole Petersen – Crypto markets rally as Bitcoin flashes bullish signs; is altseason upon us?

Table 84. Cryptoslate LTC - bottom 20 articles for sentiment magnitude

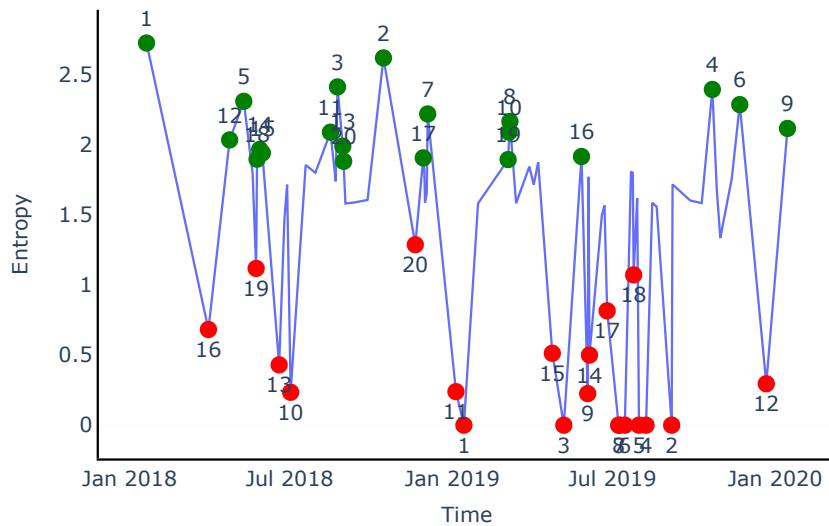
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2	2019-08-11	Mitchell Moos – Charlie Lee refutes that Litecoin is being abandoned - active development continues
3	2019-10-22	Ali Martinez – Cornerstone Global Management adds Litecoin to its crypto pay and pension plan program
4	2018-10-14	Cole Kennelly – Happy Birthday Litecoin! LTC Turns 7-Years-Old
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6	2019-04-27	Ali Martinez – Upcoming block reward halving could give Litecoin a boost
7	2018-07-11	Jacob Tuwiner – Bringing Crypto to the Masses: Litecoin and TokenPay Form Strategic Partnership
8	2018-05-01	Jonathan Kim – Litecoin Payments Slowly Moving Into the Mainstream
9	2019-09-18	Mitchell Moos – Litecoin will have succeeded when it doesn’t need Charlie Lee [INTERVIEW]
10	2018-12-20	Mitchell Moos – The Unflappening Bitcoin Cash Leaves Litecoin to Roost
11	2018-06-17	Sam Town – Charlie Lee Announces Schedule & Speaker List for Litecoin Summit
12	2020-01-02	Jonnie Emsley – Development has started on Litecoin privacy features but crowdfund still needs \$57000 in donations
13	2019-08-31	Priyeshu Garg – Analyst: unlike Litecoin Bitcoin’s halving will have a significant effect on its price
14	2019-12-05	Priyeshu Garg – Analyst: Litecoin not in danger of a 51% attack despite bottomed hashrate
15	2019-06-29	Priyeshu Garg – Litecoin and DigiByte founders cryptographically proved they created their blockchains why can’t Craig Wright?
16	2019-05-27	Omar Faridi – Litecoin’s onchain metrics show growing interest
17	2019-06-13	Ali Martinez – As the halving approaches Litecoin could plunge like it did in 2015
18	2019-04-06	Mitchell Moos – Analyzing Charlie Lee’s legendary Litecoin price predictions
19	2019-12-25	Priyeshu Garg – Here’s why the full impact of Litecoin’s August halving is yet to be seen
20	2019-06-07	Priyeshu Garg – US 2020 presidential candidate Andrew Yang meets with Litecoin founder

**Figure 42.** Top-20 articles that caused strongest and lowest negative sentiment - Cryptoslate TRX**Table 85.** Cryptoslate TRX - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-10-15	Shaurya Malwa – NBA Star Spencer Dinwiddie Shares Bitcoin Moment to Launch Sneakers Purchasable by BTC Next Season
2	2018-09-13	Trevor Ballanger – Tron Reaches New Heights with Satowallet Amid Industry Skepticism
3	2019-01-30	Priyeshu Garg – TRON's BitTorrent ICO Raises \$7 Million in 15 Minutes
4	2018-01-20	Jacob Tuwiner – An Introduction to TRON (TRX): Decentralized Content Entertainment Platform
5	2019-06-03	Mitchell Moos – Justin Sun just squandered \$4.6 million on lunch with Warren Buffett
6	2018-05-25	Sam Town – TRON Founder Justin Sun Set to Acquire Torrent BitTorrent Inc.
7	2018-04-24	Sam Town – TRON Promises \$1.7 Million Airdrop Pushes Toward Mainnet Launch and Opens Taiwan Office
8	2019-07-24	Mitchell Moos – Justin Sun's "darkest moment": apologizes for "cover-marketing" TRON to Chinese authorities then deletes apology
9	2018-03-31	Mitchell Moos – Justin Sun Announces Launch of the TRON Testnet
10	2018-12-03	Mitchell Moos – Ethereum Vs. TRON Battle Intensifies: Vitalik Buterin and Justin Sun Clash Over Twitter
11	2019-06-05	Ali Martinez – Buy the rumor and sell the news: TRON and BitTorrent technical analysis
12	2019-06-22	Mitchell Moos – Carbon is the first fiat-backed stablecoin to launch on TRON
13	2019-06-19	Ali Martinez – TRON prepares for a new mainnet upgrade incoming breakout?
14	2019-07-09	Mitchell Moos – Tron Foundation responds to Ponzi scheme-related protests at Tron partner's offices
15	2019-05-07	Mitchell Moos – Bug on TRON could have allowed a single computer to crash the network
16	2019-07-15	Priyeshu Garg – Tether accidentally issues \$5bn worth of USDT claims it was an issue with decimals
17	2019-07-08	Priyeshu Garg – Tron gets police protection after protestors storm Beijing offices
18	2019-08-20	Ali Martinez – Binance Coin and Chainlink at pivotal trading points while TRON remains bearish
19	2019-04-03	Priyeshu Garg – TRON DApps gaining market share active users spend over \$100 a day
20	2019-01-14	News Desk – Justin Sun's Rebuttal to Criticisms About TRON's Integration with BitTorrent

Table 86. Cryptoslate TRX - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-11-22	Ali Martinez – XLM TRX and ADA are bouncing but is the carnage over?
2	2019-12-22	Cole Petersen – Mickey Mouse vs. Justin Sun: crypto community reacts to recent Tron trademark rejections
3	2019-07-22	Priyeshu Garg – TRON founder Justin Sun cancels lunch with Warren Buffett due to health complications
4	2019-08-08	Jonnie Emsley – TRON price action in July indicates market maturation
5	2019-09-07	Mitchell Moos – Data suggests half of Justin Sun's Twitter followers are fake
6	2019-07-31	Ali Martinez – Price analysis of TRON and BitTorrent's TRX and BTT following Justin Sun's media fallout
7	2019-09-27	Ali Martinez – Trading indicators show EOS Cardano and TRON dropping further
8	2019-11-13	Ali Martinez – TRON's new wave of developments could soon pay off
9	2019-07-29	Omar Faridi – Justin Sun's Tron controversies: plagiarism Teslas Warren Buffet kidney stones and a deleted apology
10	2019-07-25	Mitchell Moos – BitTorrent founder accuses Justin Sun of failed payment in TRON Foundation's \$140 million acquisition
11	2019-09-06	Ali Martinez – Tron CEO Justin Sun is rescheduling his lunch with Warren Buffett
12	2019-01-05	Mitchell Moos – Ethereum TRON Iota Lead in Performance Adjusted for Risk by Sharpe Ratio Bitcoin Underperforms
13	2018-05-24	Chelsea Roh – TRON [TRX] ERC20 Token Swap – More Exchanges Join In
14	2019-01-14	News Desk – Justin Sun's Rebuttal to Criticisms About TRON - Integration with BitTorrent
15	2019-04-03	Priyeshu Garg – TRON DApps gaining market share active users spend over \$100 a day
16	2019-08-20	Ali Martinez – Binance Coin and Chainlink at pivotal trading points while TRON remains bearish
17	2019-07-08	Priyeshu Garg – Tron gets police protection after protestors storm Beijing offices
18	2019-07-15	Priyeshu Garg – Tether accidentally issues \$5bn worth of USDT claims it was an issue with decimals
19	2019-05-07	Mitchell Moos – Bug on TRON could have allowed a single computer to crash the network
20	2019-07-09	Mitchell Moos – Tron Foundation responds to Ponzi scheme-related protests at Tron partner's offices

**Figure 43.** Top-20 articles that caused strongest and lowest positive sentiment - Cryptoslate TRX

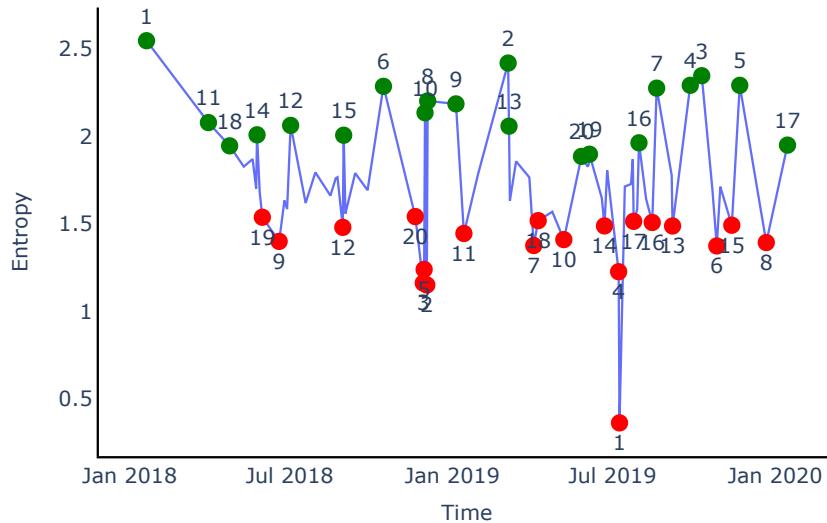
5 INTERPRETATION OF SENTIMENT INDICES

Table 87. Cryptoslate TRX - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-01-20	Jacob Tuwiner – An Introduction to TRON (TRX): Decentralized Content Entertainment Platform
2	2018-10-15	Shaurya Malwa – NBA Star Spencer Dinwiddie Shares Bitcoin Moment to Launch Sneakers Purchasable by BTC Next Season
3	2018-08-24	Jonathan Kim – New Messaging dApp TronChat to Reward TRX to Users
4	2019-10-22	Reuben Jackson – Opera Browser announces TRON wallet integration
5	2018-05-10	Jonathan Kim – TRON Prepares for Mainnet Launch and Competition with Ethereum
6	2019-11-22	Ali Martinez – XLM TRX and ADA are bouncing but is the carnage over?
7	2018-12-04	Priyeshu Garg – How EOS TRON and Ethereum Have Impacted the Gambling Industry
8	2019-03-07	Priyeshu Garg – TRON's BitTorrent Announces Incentive Plans to Increase BTT Adoption Among Its "1 Billion Computer Installed Base"
9	2020-01-15	Nick Chong – Why is "YouTube's King" PewDiePie shilling Tron and BitTorrent?
10	2019-03-06	Shaurya Malwa – Betting dApp TronBet Records \$41 Million Weekly Volume Set for \$36 Million Year-End Profit
11	2018-08-16	Jonathan Kim – Tron Community Elects BitTorrent as Super Representative and Airdrops 9 Million TRX
12	2018-04-24	Sam Town – TRON Promises \$1.7 Million Airdrop Pushes Toward Mainnet Launch and Opens Taiwan Office
13	2018-08-30	Erica Garber – Tron Foundation Debuts Tron Virtual Machine for dApp Developers
14	2018-05-28	Jonathan Kim – 2018 FIFA World Cup Embraces Blockchain as TRON Partners with vSport
15	2018-05-31	Bill DeLisle – TRON Transitions to Native Blockchain with Odyssey 2.0 Release
16	2019-05-27	Priyeshu Garg – Justin Sun announces an announcement TRON and BitTorrent jump
17	2018-11-29	Priyeshu Garg – TRON dApp Usage Now Exceeds Ethereum TRX Storms Ahead With Major Gains
18	2018-05-25	Sam Town – TRON Founder Justin Sun Set to Acquire Torrent BitTorrent Inc.
19	2019-03-05	Priyeshu Garg – TRON Partners with Tether to Launch TRC20 Version of USDT Stablecoin
20	2018-08-31	Sam Town – What is Project Atlas? Justin Sun Reveals Details of New Tokenized BitTorrent Platform on Tron

Table 88. Cryptoslate TRX - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2019-01-14	News Desk – Justin Sun's Rebuttal to Criticisms About TRON's Integration with BitTorrent
2	2019-09-06	Ali Martinez – Tron CEO Justin Sun is rescheduling his lunch with Warren Buffett
3	2019-05-07	Mitchell Moos – Bug on TRON could have allowed a single computer to crash the network
4	2019-08-08	Jonnie Emsley – TRON price action in July indicates market maturation
5	2019-07-31	Ali Martinez – Price analysis of TRON and BitTorrent's TRX and BTT following Justin Sun's media fallout
6	2019-07-15	Priyeshu Garg – Tether accidentally issues \$5bn worth of USDT claims it was an issue with decimals
7	2019-07-09	Mitchell Moos – Tron Foundation responds to Ponzi scheme-related protests at Tron partner's offices
8	2019-07-08	Priyeshu Garg – Tron gets police protection after protestors storm Beijing offices
9	2019-06-03	Mitchell Moos – Justin Sun just squandered \$4.6 million on lunch with Warren Buffett
10	2018-07-02	Austin Tuwiner – TRON Foundation Burns 50 Billion TRX ERC20 Tokens
11	2019-01-05	Mitchell Moos – Ethereum TRON Iota Lead in Performance Adjusted for Risk by Sharpe Ratio Bitcoin Underperforms
12	2019-12-22	Cole Petersen – Mickey Mouse vs. Justin Sun: crypto community reacts to recent Tron trademark rejections
13	2018-06-19	Chelsea Roh – TRON Token Migration Notice - TRX Price Rebounds 8% Today
14	2019-06-05	Ali Martinez – Buy the rumor and sell the news: TRON and BitTorrent technical analysis
15	2019-04-24	Mitchell Moos – Skepticism around TRON's alleged partnership with Liverpool FC
16	2018-03-31	Mitchell Moos – Justin Sun Announces Launch of the TRON Testnet
17	2019-06-25	Ali Martinez – TRON Foundation announces ambitious \$20 million TRX buyback
18	2019-07-25	Mitchell Moos – BitTorrent founder accuses Justin Sun of failed payment in TRON Foundation's \$140 million acquisition
19	2018-05-24	Chelsea Roh – TRON [TRX] ERC20 Token Swap - More Exchanges Join In
20	2018-11-20	Mitchell Moos – Kobe Bryant to Speak at TRON's niTROn Innovation Summit

**Figure 44.** Top-20 articles that caused strongest and lowest neutral sentiment - Cryptoslate TRX**Table 89.** Cryptoslate TRX - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-01-20	Jacob Tuwiner - An Introduction to TRON (TRX): Decentralized Content Entertainment Platform
2	2019-03-05	Priyeshu Garg - TRON Partners with Tether to Launch TRC20 Version of USDT Stablecoin
3	2019-10-10	Priyeshu Garg - Gambling and DeFi keep dapps afloat as transaction volume drops; Ethereum EOS and Tron leading
4	2019-09-27	Ali Martinez - Trading indicators show EOS Cardano and TRON dropping further
5	2019-11-22	Ali Martinez - XLM TRX and ADA are bouncing but is the carnage over?
6	2018-10-15	Shaurya Malwa - NBA Star Spencer Dinwiddie Shares Bitcoin Moment to Launch Sneakers Purchasable by BTC Next Season
7	2019-08-20	Ali Martinez - Binance Coin and Chainlink at pivotal trading points while TRON remains bearish
8	2018-12-04	Priyeshu Garg - How EOS TRON and Ethereum Have Impacted the Gambling Industry
9	2019-01-05	Mitchell Moos - Ethereum TRON Iota Lead in Performance Adjusted for Risk by Sharpe Ratio Bitcoin Underperforms
10	2018-12-01	Mitchell Moos - TRON Ramping Up Privacy Adopting zk-SNARKs from Zcash
11	2018-03-31	Mitchell Moos - Justin Sun Announces Launch of the TRON Testnet
12	2018-07-02	Austin Tuwiner - TRON Foundation Burns 50 Billion TRX ERC20 Tokens
13	2019-03-06	Shaurya Malwa - Betting dApp TronBet Records \$41 Million Weekly Volume Set for \$36 Million Year-End Profit
14	2018-05-25	Sam Town - TRON Founder Justin Sun Set to Acquire Torrent BitTorrent Inc.
15	2018-08-31	Sam Town - What is Project Atlas? Justin Sun Reveals Details of New Tokenized BitTorrent Platform on Tron
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17	2020-01-15	Nick Chong - Why is "YouTube's King" PewDiePie shilling Tron and BitTorrent?
18	2018-04-24	Sam Town - TRON Promises \$1.7 Million Airdrop Pushes Toward Mainnet Launch and Opens Taiwan Office
19	2019-06-05	Ali Martinez - Buy the rumor and sell the news: TRON and BitTorrent technical analysis
20	2019-05-27	Priyeshu Garg - Justin Sun announces an announcement TRON and BitTorrent jump

Table 90. Cryptoslate TRX - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2019-07-09	Mitchell Moos – Tron Foundation responds to Ponzi scheme-related protests at Tron partner's offices
2	2018-12-03	Mitchell Moos – Ethereum Vs. TRON Battle Intensifies: Vitalik Buterin and Justin Sun Clash Over Twitter
3	2018-11-29	Priyeshu Garg – TRON dApp Usage Now Exceeds Ethereum TRX Storms Ahead With Major Gains
4	2019-07-08	Priyeshu Garg – Tron gets police protection after protestors storm Beijing offices
5	2018-11-30	Priyeshu Garg – TRON Launches a \$100 Million Fund for Blockchain Gaming
6	2019-10-27	Reuben Jackson – Popular dApp game Knight Story turns to TRON for next iteration
7	2019-04-03	Priyeshu Garg – TRON DApps gaining market share active users spend over \$100 a day
8	2019-12-22	Cole Petersen – Mickey Mouse vs. Justin Sun: crypto community reacts to recent Tron trademark rejections
9	2018-06-19	Chelsea Roh – TRON Token Migration Notice - TRX Price Rebounds 8% Today
10	2019-05-07	Mitchell Moos – Bug on TRON could have allowed a single computer to crash the network
11	2019-01-14	News Desk – Justin Sun's Rebuttal to Criticisms About TRON's Integration with BitTorrent
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17	2019-07-25	Mitchell Moos – BitTorrent founder accuses Justin Sun of failed payment in TRON Foundation's \$140 million acquisition
18	2019-04-08	Priyeshu Garg – Justin Sun reveals launch date for second-layer scaling - 100X scalability for TRON
19	2018-05-31	Bill DeLisle – TRON Transitions to Native Blockchain with Odyssey 2.0 Release
20	2018-11-20	Mitchell Moos – Kobe Bryant to Speak at TRON – niTRON Innovation Summit

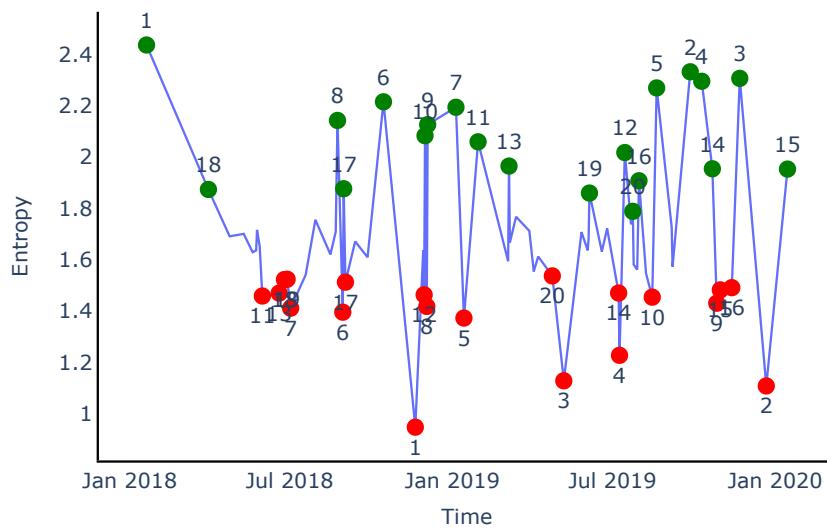
**Figure 45.** Top-20 articles that caused strongest and lowest sentiment - Cryptoslate TRX

Table 91. Cryptoslate TRX - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-01-20	Jacob Tuwiner – An Introduction to TRON (TRX): Decentralized Content Entertainment Platform
2	2019-09-27	Ali Martinez – Trading indicators show EOS Cardano and TRON dropping further
3	2019-11-22	Ali Martinez – XLM TRX and ADA are bouncing but is the carnage over?
4	2019-10-10	Priyeshu Garg – Gambling and DeFi keep dapps afloat as transaction volume drops; Ethereum EOS and Tron leading
5	2019-08-20	Ali Martinez – Binance Coin and Chainlink at pivotal trading points while TRON remains bearish
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17	2018-08-31	Sam Town – What is Project Atlas? Justin Sun Reveals Details of New Tokenized BitTorrent Platform on Tron
18	2018-03-31	Mitchell Moos – Justin Sun Announces Launch of the TRON Testnet
19	2019-06-05	Ali Martinez – Buy the rumor and sell the news: TRON and BitTorrent technical analysis
20	2019-07-24	Mitchell Moos – Justin Sun's "darkest moment": apologizes for "cover-marketing" TRON to Chinese authorities

Table 92. Cryptoslate TRX - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-11-20	Mitchell Moos – Kobe Bryant to Speak at TRON's niTRON Innovation Summit
2	2019-12-22	Cole Petersen – Mickey Mouse vs. Justin Sun: crypto community reacts to recent Tron trademark rejections
3	2019-05-07	Mitchell Moos – Bug on TRON could have allowed a single computer to crash the network
4	2019-07-09	Mitchell Moos – Tron Foundation responds to Ponzi scheme-related protests at Tron partner's offices
5	2019-01-14	News Desk – Justin Sun's Rebuttal to Criticisms About TRON's Integration with BitTorrent
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7	2018-07-02	Austin Tuwiner – TRON Foundation Burns 50 Billion TRX ERC20 Tokens
8	2018-12-03	Mitchell Moos – Ethereum Vs. TRON Battle Intensifies: Vitalik Buterin and Justin Sun Clash Over Twitter
9	2019-10-27	Reuben Jackson – Popular dApp game Knight Story turns to TRON for next iteration
10	2019-08-15	Mitchell Moos – Is TRON's Sun Network a marketing gimmick? Comparisons with Ethereum and EOS metrics
11	2018-05-31	Bill DeLisle – TRON Transitions to Native Blockchain with Odyssey 2.0 Release
12	2018-11-30	Priyeshu Garg – TRON Launches a \$100 Million Fund for Blockchain Gaming
13	2018-06-19	Chelsea Roh – TRON Token Migration Notice - TRX Price Rebounds 8% Today
14	2019-07-08	Priyeshu Garg – Tron gets police protection after protestors storm Beijing offices
15	2019-10-31	Reuben Jackson – TRON Blockchain integrates with Samsung blockchain keystore
16	2019-11-13	Ali Martinez – TRON's new wave of developments could soon pay off
17	2018-09-02	Jonnie Emsley – Tron's Daily Transaction Count Surges to a Third of Ethereum
18	2018-06-25	Chelsea Roh – TRON (TRX) Independence Day - Project Officially Breaks Away from Ethereum
19	2018-06-28	Jonnie Emsley – TRON and ZenCash Added As Payment Methods for Pornhub
20	2019-04-24	Mitchell Moos – Skepticism around TRON's alleged partnership with Liverpool FC

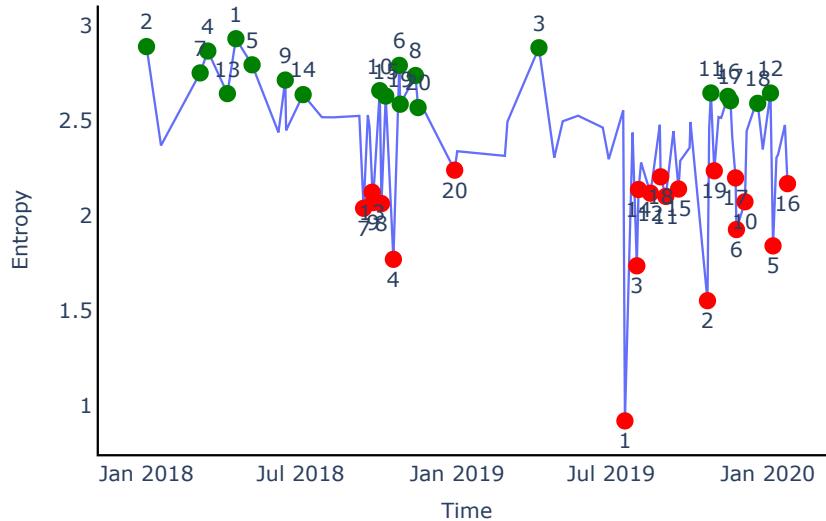


Figure 46. Top-20 articles that caused strongest and lowest negative sentiment - Cryptoslate XRP

Table 93. Cryptoslate XRP - top 20 articles for negative sentiment

Rank	Date	Author - Article
1	2018-04-16	Shiraz Jagati – Ripple Urges UK Regulators to Establish a Consistent Cryptocurrency Framework
2	2018-01-01	Bill DeLisle – Why Did Ripple Surge 35334% In 2017?
3	2019-04-07	Priyeshu Garg – YTD performance report: Bitcoin Ethereum XRP Litecoin and Bitcoin Cash
4	2018-03-14	Shiraz Jagati – BBVA CEO Confirms Success with Ripple Platform Experiment
5	2018-05-05	Matt Breen – Ripple Labs Hit With Class-Action Lawsuit
6	2018-10-25	Priyeshu Garg – Sydney Woman Nabbed by Police for Stealing 100000 XRP
7	2018-03-05	Shiraz Jagati – Ripple Partners with Payment Provider Fleetcor to Foster XRP Use
8	2018-11-13	Mitchell Moos – How Bitcoin Ethereum and Ripple-Backed Loans Will Change Crypto
9	2018-06-13	Jonathan Kim – Ripple CEO: “Blockchain Will Not Disrupt Banks” and “China Controls Bitcoin”
10	2018-10-02	John Bogna – Ripple Launches xRapid at Swell
11	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
12	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
13	2018-04-06	Mitchell Moos – Is Ripple Classified as a Security Under U.S. Law?
14	2018-07-04	Jonathan Kim – Ripple Faces Third Securities Fraud Lawsuit
15	2018-10-09	John Bogna – XRP Olympic Petition Tops 10K Signatures Raises Goal to 15K
16	2019-11-15	Ali Martinez – Bitcoin Ethereum and XRP prepare for a significant move
17	2019-11-18	Joseph Young – Altcoins retrace to 2017 levels: why it’s a critical moment for Ethereum XRP et al.
18	2019-12-20	Ali Martinez – Ripple secures \$200m investment at \$10 billion valuation
19	2018-10-26	John Bogna – Ripple Cofounder Chris Larsen at Money2020 FinTech Conference: “Silicon Valley Has Missed the Boat”
20	2018-11-16	Shaurya Malwa – Ripple (XRP) Officially Hits Coinbase Custody

Table 94. Cryptoslate XRP - bottom 20 articles for negative sentiment

Rank	Date	Author - Article
1	2019-07-17	Mitchell Moos – Former Ripple employee speaks out XRP price doesn't reflect xRapid use
2	2019-10-22	Joseph Young – Why liquidity of XRP in Mexico is surging after MoneyGram partnership
3	2019-07-31	Priyeshu Garg – Ripple CEO says Facebook went too far with Libra
4	2018-10-18	John Bogna – Ripple Labs Expanding Via Partnerships with Gates Foundation Omni and Nexo
5	2020-01-07	Ali Martinez – XRP's technical indicators estimate lower prices despite the bullishness
6	2019-11-25	Priyeshu Garg – Payment platform MoneyNetint wins award for most connections on the Ripple network
7	2018-09-13	Aliesha Duffin – RippleNet to Make it Easier for Thai Workers to Send Money Home
8	2018-10-04	John Bogna – Petition to Make XRP the Official Cryptocurrency of the 2020 Olympics at Over 5K Signatures
9	2018-09-24	Joseph Young – Hostility From XRP Supporters Forces Platform to Remove Top Ripple Accounts Section
10	2019-12-05	Ali Martinez – XRP forcing some investors out after massive sell-offs and a YTD return of -40%
11	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
12	2019-08-16	Ali Martinez – What's next for Ethereum XRP and Litecoin after the recent plunge ?
13	2018-09-23	Joseph Young – Billionaire Investor Novogratz Discusses Ripple 3x Surge: 3 Possible Factors
14	2019-08-02	Priyeshu Garg – One billion XRP moved from Ripple's escrow mistaken for a whale dump
15	2019-09-18	Jonnie Emsley – XRP breaks out of bear-trend in monster rally
16	2020-01-24	Ali Martinez – Data shows Ripple sold less XRP in Q4 2019 so why does its price continue to decline?
17	2019-11-24	Joseph Young – How XRP may have crucially avoided a much bigger price drop this weekend
18	2019-08-28	Ali Martinez – Ripple CEO Brad Garlinghouse takes to Twitter to clarify the "FUD" around XRP
19	2019-10-30	Ali Martinez – XRP network activity is on the rise as its price consolidates
20	2018-12-29	Mitchell Moos – Kraken Battles with the XRP Army Over Ripple Semantics

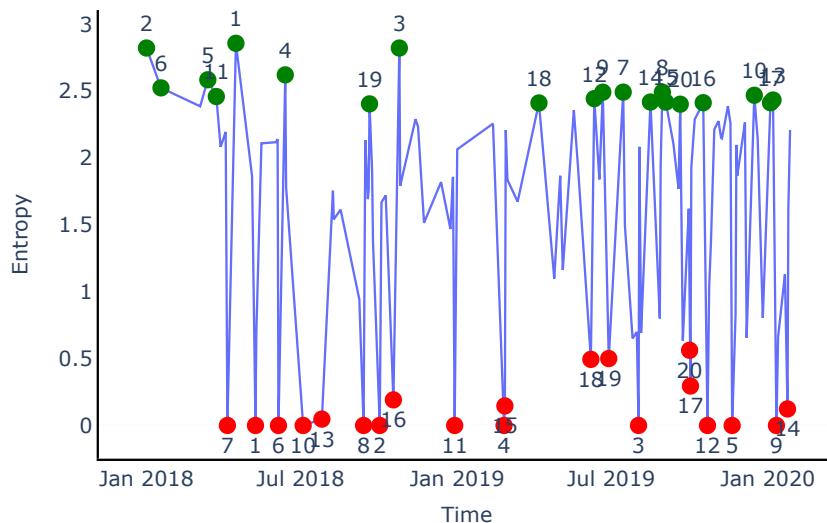
**Figure 47.** Top-20 articles that caused strongest and lowest positive sentiment - Cryptoslate XRP

Table 95. Cryptoslate XRP - top 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-04-16	Shiraz Jagati – Ripple Urges UK Regulators to Establish a Consistent Cryptocurrency Framework
2	2018-01-01	Bill DeLisle – Why Did Ripple Surge 3534% In 2017?
3	2018-10-25	Priyeshu Garg – Sydney Woman Nabbed by Police for Stealing 100000 XRP
4	2018-06-13	Jonathan Kim – Ripple CEO: “Blockchain Will Not Disrupt Banks” and “China Controls Bitcoin”
5	2018-03-14	Shiraz Jagati – BBVA CEO Confirms Success with Ripple Platform Experiment
6	2018-01-18	Chris Hall – Ripple’s Co-Founder Loses Almost \$50 Billion In Paper Wealth During Crypto Crash
7	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?
8	2019-08-30	Ali Martinez – US banking giant PNC goes live on RippleNet
9	2019-06-21	Ali Martinez – Top 3 altcoins: Ethereum XRP and Litecoin technical analysis
10	2019-12-16	Ali Martinez – Low volatility in BTC ETH and XRP could signal the next move
11	2018-03-24	Shiraz Jagati – Santander Partners With Ripple to Create a New Cross-Border Payment App
12	2019-06-11	Ali Martinez – Could Litecoin overtake XRP before the halving?
13	2020-01-07	Ali Martinez – XRP’s technical indicators estimate lower prices despite the bullishness
14	2019-08-16	Ali Martinez – What’s next for Ethereum XRP and Litecoin after the recent plunge ?
15	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
16	2019-10-17	Ali Martinez – XRP’s technical indicators are bullish in anticipation of Ripple Swell
17	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
18	2019-04-07	Priyeshu Garg – YTD performance report: Bitcoin Ethereum XRP Litecoin and Bitcoin Cash
19	2018-09-20	Joseph Young – Ripple Sees Huge 40 Percent Gain As Crypto Market Adds \$12 Billion Is the Bear Market Over?
20	2019-09-20	Ali Martinez – Ethereum XRP and Litecoin stage major recoveries indicating the start of a new altseason

Table 96. Cryptoslate XRP - bottom 20 articles for positive sentiment

Rank	Date	Author - Article
1	2018-05-09	Sam Town – South Korean Exchange Coinone Leverages Ripple Technology in New Cross-Border Payment System
2	2018-10-02	John Bogna – Ripple Launches xRapid at Swell
3	2019-08-02	Priyeshu Garg – One billion XRP moved from Ripple’s escrow mistaken for a whale dump
4	2019-02-25	Mitchell Moos – When XRP? Coinbase Pro Adds Ripple XRP
5	2019-11-20	Ali Martinez – Research shows 0.2% of XRP transactions are illegal
6	2018-06-05	Jonnie Emsley – Ripple Lawyers Up With Former Chair of SEC in Legal Battle
7	2018-04-06	Mitchell Moos – Is Ripple Classified as a Security Under U.S. Law?
8	2018-09-13	Aliesha Duffin – RippleNet to Make it Easier for Thai Workers to Send Money Home
9	2020-01-11	Ali Martinez – New evidence suggests that XRP could be deemed a security
10	2018-07-04	Jonathan Kim – Ripple Faces Third Securities Fraud Lawsuit
11	2018-12-29	Mitchell Moos – Kraken Battles with the XRP Army Over Ripple Semantics
12	2019-10-22	Joseph Young – Why liquidity of XRP in Mexico is surging after MoneyGram partnership
13	2018-07-26	Shaurya Malwa – Report: Ripple Sheds Light on XRP Usage in Q2 2018
14	2020-01-24	Ali Martinez – Data shows Ripple sold less XRP in Q4 2019 so why does its price continue to decline?
15	2019-02-26	Avi Felman – Did Insiders Trade XRP Before the Coinbase Listing?
16	2018-10-18	John Bogna – Ripple Labs Expanding Via Partnerships with Gates Foundation Omni and Nexo
17	2019-10-02	Ali Martinez – Crypto Rating Council says XRP and Stellar are more like securities
18	2019-06-07	Priyeshu Garg – Thailand’s largest commercial bank redacts statement on integrating Ripple’s XRP
19	2019-06-28	Seth Goldfarb – Plaintiff and lead counsel named in Ripple class action lawsuit over XRP offering
20	2019-10-01	Mitchell Moos – Analyzing wealth concentration on Bitcoin Ethereum and XRP

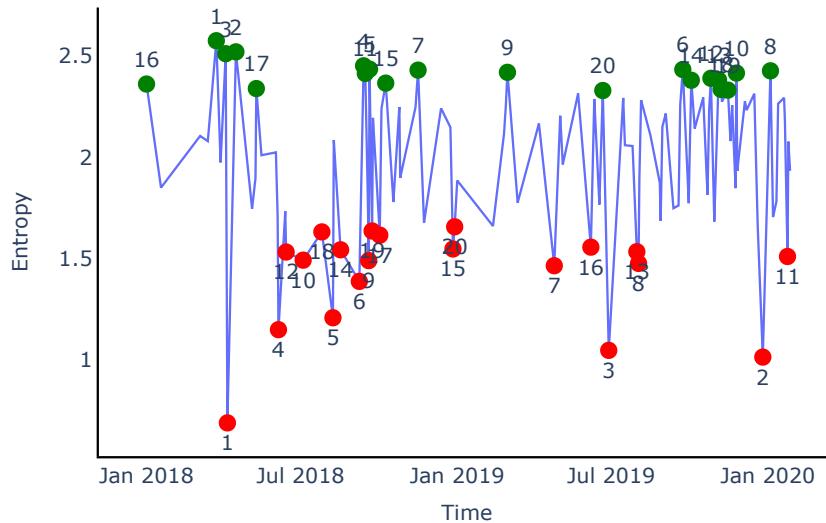


Figure 48. Top-20 articles that caused strongest and lowest neutral sentiment - Cryptoslate XRP

Table 97. Cryptoslate XRP - top 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-03-24	Shiraz Jagati – Santander Partners With Ripple to Create a New Cross-Border Payment App
2	2018-04-16	Shiraz Jagati – Ripple Urges UK Regulators to Establish a Consistent Cryptocurrency Framework
3	2018-04-04	Shiraz Jagati – Ripple Enters the Metal Trading Market with Latest Partnership
4	2018-09-13	Aliesha Duffin – RippleNet to Make it Easier for Thai Workers to Send Money Home
5	2018-09-20	Joseph Young – Ripple Sees Huge 40 Percent Gain As Crypto Market Adds \$12 Billion Is the Bear Market Over?
6	2019-09-23	Ali Martinez – Ethereum XRP and Litecoin prices show indecision in the market
7	2018-11-16	Shaurya Malwa – Ripple (XRP) Officially Hits Coinbase Custody
8	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
9	2019-03-01	Mitchell Moos – Ripple XRP Now Available to Retail Investors on Coinbase and Its Mobile Apps
10	2019-11-25	Priyeshu Garg – Payment platform MoneyNetint wins award for most connections on the Ripple network
11	2018-09-15	Trevor Ballanger – National Commercial Bank of Saudi Arabia Joins Forces with RippleNet
12	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
13	2019-11-04	Ali Martinez – Bitcoin Ethereum and XRP consolidate anticipating a major price move
14	2019-10-03	Ali Martinez – Ripple's Xpring aims to make XRP the internet of money
15	2018-10-09	John Bogna – XRP Olympic Petition Tops 10K Signatures Raises Goal to 15K
16	2018-01-01	Bill DeLisle – Why Did Ripple Surge 35334% In 2017?
17	2018-05-10	Jacob Tuwiner – Ripple Announces Successful xRapid Transfer from US to Mexico
18	2019-11-07	Ali Martinez – Ripple CEO discusses plans for 2020; where is XRP heading next?
19	2019-11-15	Ali Martinez – Bitcoin Ethereum and XRP prepare for a significant move
20	2019-06-21	Ali Martinez – Top 3 altcoins: Ethereum XRP and Litecoin technical analysis

Table 98. Cryptoslate XRP - bottom 20 articles for neutral sentiment

Rank	Date	Author - Article
1	2018-04-06	Mitchell Moos – Is Ripple Classified as a Security Under U.S. Law?
2	2019-12-26	Cole Petersen – This bearish formation spells trouble for XRP; here's where it may drop to next
3	2019-06-28	Seth Goldfarb – Plaintiff and lead counsel named in Ripple class action lawsuit over XRP offering
4	2018-06-05	Jonnie Emsley – Ripple Lawyers Up With Former Chair of SEC in Legal Battle
5	2018-08-08	Shaurya Malwa – Ripple Partners with Madonna for Malawi Children's Fundraiser
6	2018-09-08	Trevor Ballanger – Top Legal Counsel for Ripple Exits Amid Continuing Security Controversy
7	2019-04-25	Mitchell Moos – As XRP underperforms Ripple and CTO David Schwartz sell-off holdings
8	2019-08-02	Priyeshu Garg – One billion XRP moved from Ripple's escrow mistaken for a whale dump
9	2018-09-19	Chelsea Roh – PNC Bank Signs On to Use Ripple's xCurrent Joins RippleNet
10	2018-07-04	Jonathan Kim – Ripple Faces Third Securities Fraud Lawsuit
11	2020-01-24	Ali Martinez – Data shows Ripple sold less XRP in Q4 2019 so why does its price continue to decline?
12	2018-06-14	Chelsea Roh – Western Union CEO States Ripple (XRP) Payments Aren't Cheaper
13	2019-07-31	Priyeshu Garg – Ripple CEO says Facebook went too far with Libra
14	2018-08-17	Chelsea Roh – Ripple's xRapid Secures Exchange Partnership with Bittrex and More
15	2018-12-27	Mitchell Moos – Could Ripple's Multi-Billion Dollar XRP Reserves Pose a Risk to Token Holders?
16	2019-06-07	Priyeshu Garg – Thailand's largest commercial bank redacts statement on integrating Ripple's XRP
17	2018-10-02	John Bogna – Ripple Launches xRapid at Swell
18	2018-07-26	Shaurya Malwa – Report: Ripple Sheds Light on XRP Usage in Q2 2018
19	2018-09-23	Joseph Young – Billionaire Investor Novogratz Discusses Ripple 3x Surge: 3 Possible Factors
20	2018-12-29	Mitchell Moos – Kraken Battles with the XRP Army Over Ripple Semantics

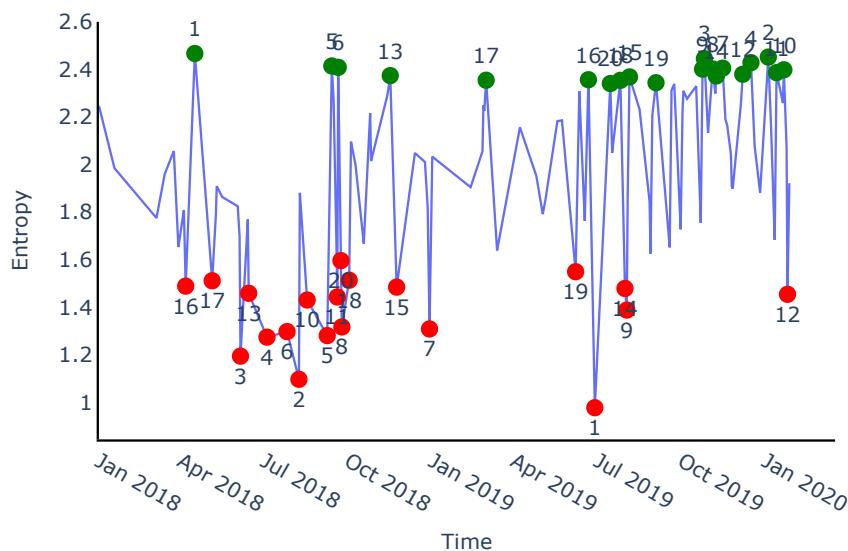
**Figure 49.** Top-20 articles that caused strongest and lowest sentiment - Cryptoslate XRP

Table 99. Cryptoslate XRP - top 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2018-04-16	Shiraz Jagati – Ripple Urges UK Regulators to Establish a Consistent Cryptocurrency Framework
2	2020-01-04	Ali Martinez – Bitcoin Ethereum and XRP may be preparing for a breakout
3	2019-10-26	Ali Martinez – Ethereum XRP and Litecoin are on the verge of a major trend change
4	2019-12-16	Ali Martinez – Low volatility in BTC ETH and XRP could signal the next move
5	2018-09-13	Aliesha Duffin – RippleNet to Make it Easier for Thai Workers to Send Money Home
6	2018-09-20	Joseph Young – Ripple Sees Huge 40 Percent Gain As Crypto Market Adds \$12 Billion Is the Bear Market Over?
7	2019-11-15	Ali Martinez – Bitcoin Ethereum and XRP prepare for a significant move
8	2019-11-04	Ali Martinez – Bitcoin Ethereum and XRP consolidate anticipating a major price move
9	2019-10-24	Ali Martinez – A bearish technical analysis for Bitcoin Ethereum XRP and Litecoin; but what if bullish?
10	2020-01-21	Ali Martinez – Ethereum XRP and Litecoin could be bound for a steeper decline
11	2020-01-13	Ali Martinez – Bitcoin Ethereum and XRP sit at a make-or-break point
12	2019-12-07	Ali Martinez – Ethereum XRP and Litecoin remain stagnant; where will they head next?
13	2018-11-16	Shaurya Malwa – Ripple (XRP) Officially Hits Coinbase Custody
14	2019-11-08	Ali Martinez – Bitcoin price drops below \$9000 Ethereum and XRP following
15	2019-08-05	Ali Martinez – Will Ethereum XRP and Binance Coin follow Bitcoin's uptrend?
16	2019-06-21	Ali Martinez – Top 3 altcoins: Ethereum XRP and Litecoin technical analysis
17	2019-03-01	Mitchell Moos – Ripple XRP Now Available to Retail Investors on Coinbase and Its Mobile Apps
18	2019-07-26	Ali Martinez – Ethereum XRP and Litecoin appear to be consolidating before their next big move
19	2019-09-03	Ali Martinez – Ethereum XRP and Litecoin look bearish against BTC but promising against USD
20	2019-07-15	Ali Martinez – After the recent drop is Ethereum XRP and Litecoin due for a rebound?

Table 100. Cryptoslate XRP - bottom 20 articles for sentiment magnitude

Rank	Date	Author - Article
1	2019-06-28	Seth Goldfarb – Plaintiff and lead counsel named in Ripple class action lawsuit over XRP offering
2	2018-08-08	Shaurya Malwa – Ripple Partners with Madonna for Malawi Children's Fundraiser
3	2018-06-05	Jonnie Emsley – Ripple Lawyers Up With Former Chair of SEC in Legal Battle
4	2018-07-04	Jonathan Kim – Ripple Faces Third Securities Fraud Lawsuit
5	2018-09-08	Trevor Ballanger – Top Legal Counsel for Ripple Exits Amid Continuing Security Controversy
6	2018-07-26	Shaurya Malwa – Report: Ripple Sheds Light on XRP Usage in Q2 2018
7	2018-12-29	Mitchell Moos – Kraken Battles with the XRP Army Over Ripple Semantics
8	2018-09-24	Joseph Young – Hostility From XRP Supporters Forces Platform to Remove Top Ripple Accounts Section
9	2019-08-02	Priyeshu Garg – One billion XRP moved from Ripple's escrow mistaken for a whale dump
10	2018-08-17	Chelsea Roh – Ripple's xRapid Secures Exchange Partnership with Bittrex and More
11	2018-09-19	Chelsea Roh – PNC Bank Signs On to Use Ripple's xCurrent Joins RippleNet
12	2020-01-25	Cole Petersen – Ripple CEO drops IPO hint but XRP investors aren't amused
13	2018-06-14	Chelsea Roh – Western Union CEO States Ripple (XRP) Payments Aren't Cheaper
14	2019-07-31	Priyeshu Garg – Ripple CEO says Facebook went too far with Libra
15	2018-11-23	Mitchell Moos – Ripple's success: Why XRP Held Fast Amidst the Crypto Market Meltdown
16	2018-04-06	Mitchell Moos – Is Ripple Classified as a Security Under U.S. Law?
17	2018-05-05	Matt Breen – Ripple Labs Hit With Class-Action Lawsuit
18	2018-10-02	John Bogna – Ripple Launches xRapid at Swell
19	2019-06-07	Priyeshu Garg – Thailand's largest commercial bank redacts statement on integrating Ripple's XRP
20	2018-09-23	Joseph Young – Billionaire Investor Novogratz Discusses Ripple 3x Surge: 3 Possible Factors

5.2. Authors

In this section we decompose the sentiment indices in terms of the sentiment signal extracted from authors. We present Algorithm 3 for the decomposition and include the results in Figures 51 - 59 in addition to the discussion included in the paper.

```

Input : time-series of cumulative recursive proportions  $\{X_t\}$  that the sentiment index is based on, list  $M$  of metadata (author, article title, date) for each  $n$ -gram of  $\{X_t\}$ , set  $Q = \{q_0, \dots, q_p\}$  of quantile levels of the distribution that the entropy was extracted from, which we consider are of interest for our analysis, quantile level  $q_s$  which we consider as determining the area of the most significant articles
Output : list  $W$  of the most influential authors for the index together with their confidence intervals  $W_{CI}$  after weighting
Initialisation: group the  $n$ -gram values of  $\{X_t\}$  per day:  $D = \left\{ \{X_{i,t}\}_{i=1}^{d_t}, \dots, \{X_{i,T}\}_{i=1}^{d_T} \right\}$ ,  $Y = \emptyset$ 
for  $t \leftarrow t_1$  to  $T$  do
    density $_t$   $\leftarrow$  construct density of  $\{X_{i,t}\}_{i=1}^{d_t}$ ;
    for  $q \leftarrow q_0$  to  $q_p$  do
         $q_{val} \leftarrow$  compute  $q$ -th quantile of density $_t$ ;
         $q_{idx} \leftarrow \{j : X_{j,t} \geq q_{val}\}$ ;
        // use  $j$  to extract author for the corresponding  $n$ -grams from  $M$ 
         $Y[t,q] = M[j]$ ;
    end
end
 $W \leftarrow$  author that has produced the most (per day  $t$ )  $n$ -grams that belong in  $Y[:, q_s]$ ;
// final score is the average number of times each author was dominant within a period of  $T = 1$  week,
// weighted by the number of weeks they were active within the period we study (01/2018 - 01/2020)
 $W_{weekly}[author] \leftarrow |\{Y[t, q_s], \text{ if author dominant in week of day } t\}_{t=t_1}^T|$ ;
 $W_s[author] \leftarrow \text{average}(W_{weekly}[author]) \times \frac{1}{\# \text{active weeks}}$ ;
// error bars for each author
 $W_{CI}[author] \leftarrow \text{std}(W_{weekly}[author]) \times \frac{1}{\# \text{active weeks}}$ 
```

Algorithm 3: Identify most influential authors for given entropy-based sentiment index.

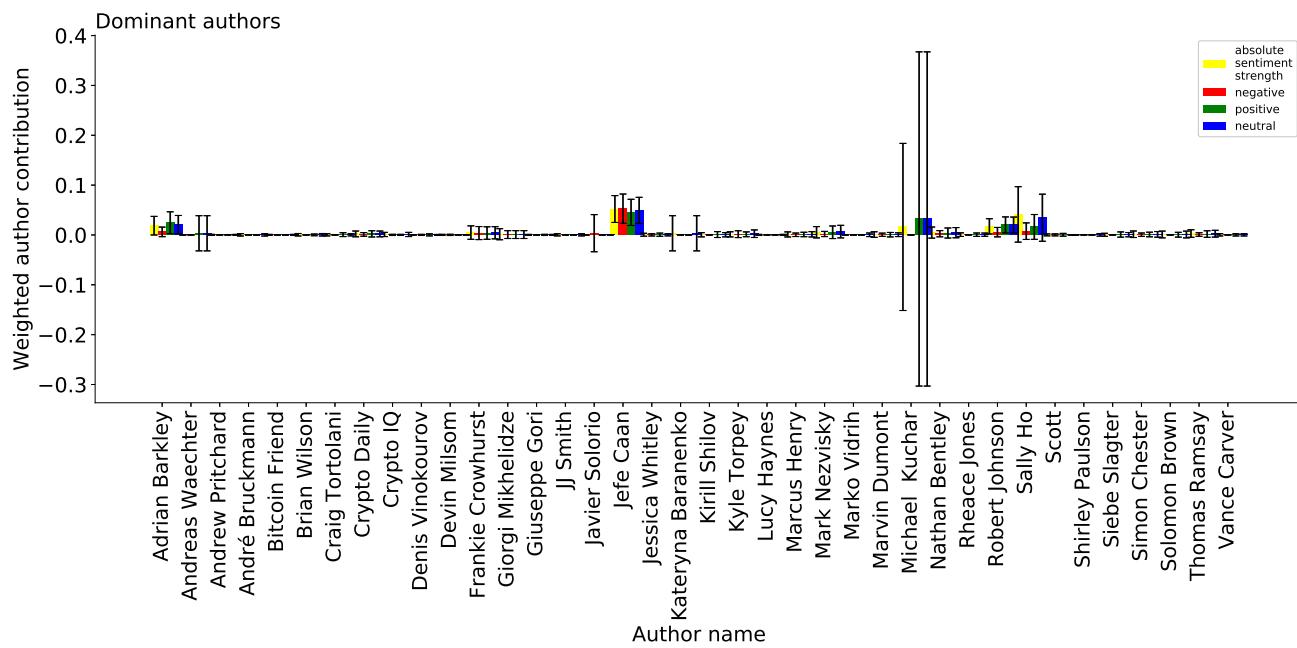


Figure 50. Main contributing authors and their sentiment tendencies for Cryptodaily articles on BTC, estimated using Algorithm 3.

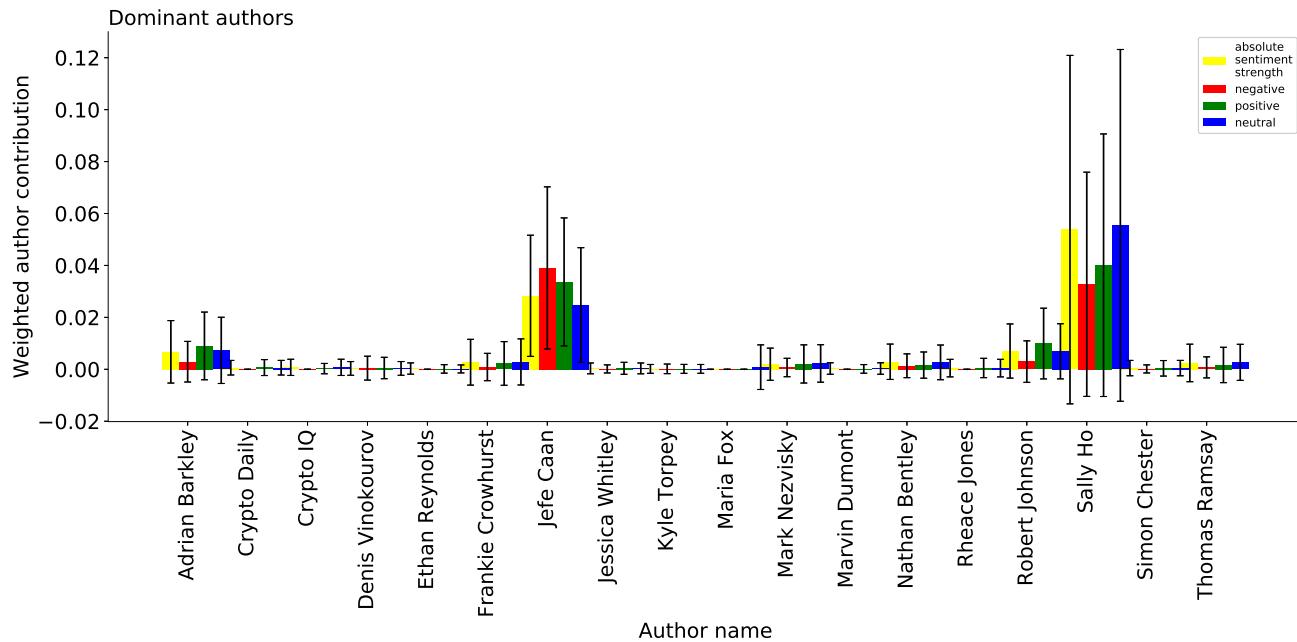


Figure 51. Main contributing authors and their sentiment tendencies for Cryptodaily articles on ETH, estimated using Algorithm 3.

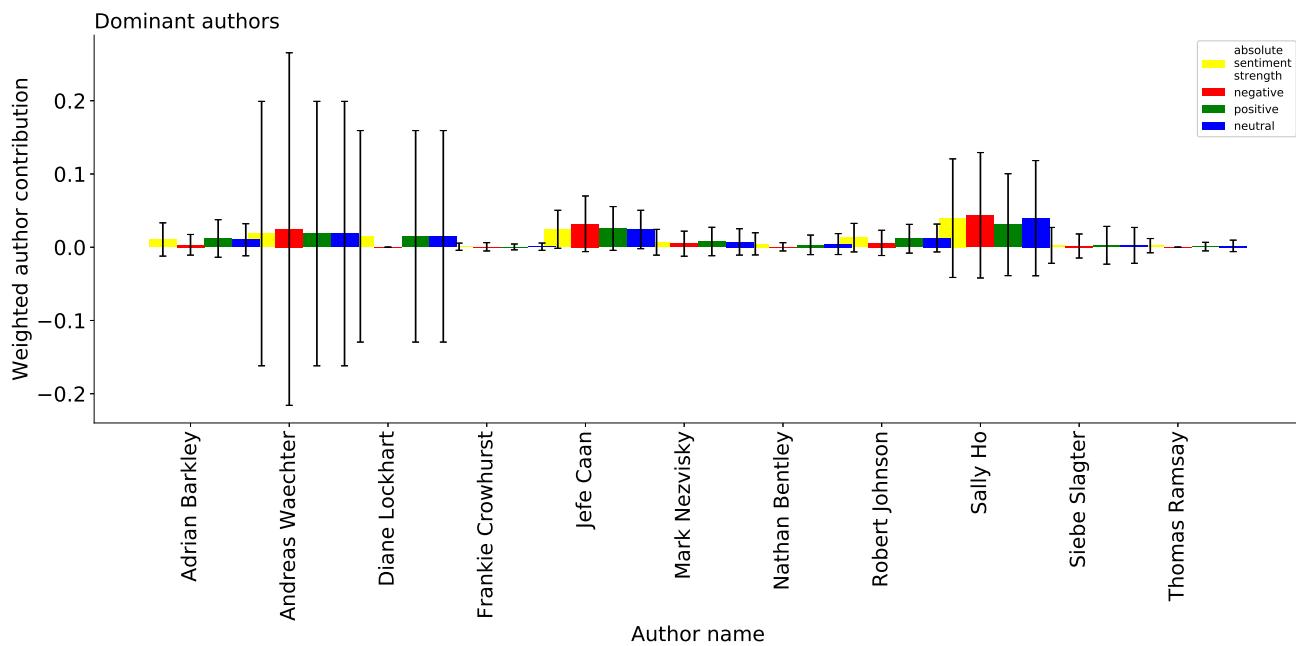


Figure 52. Main contributing authors and their sentiment tendencies for Cryptodaily articles on LTC, estimated using Algorithm 3.

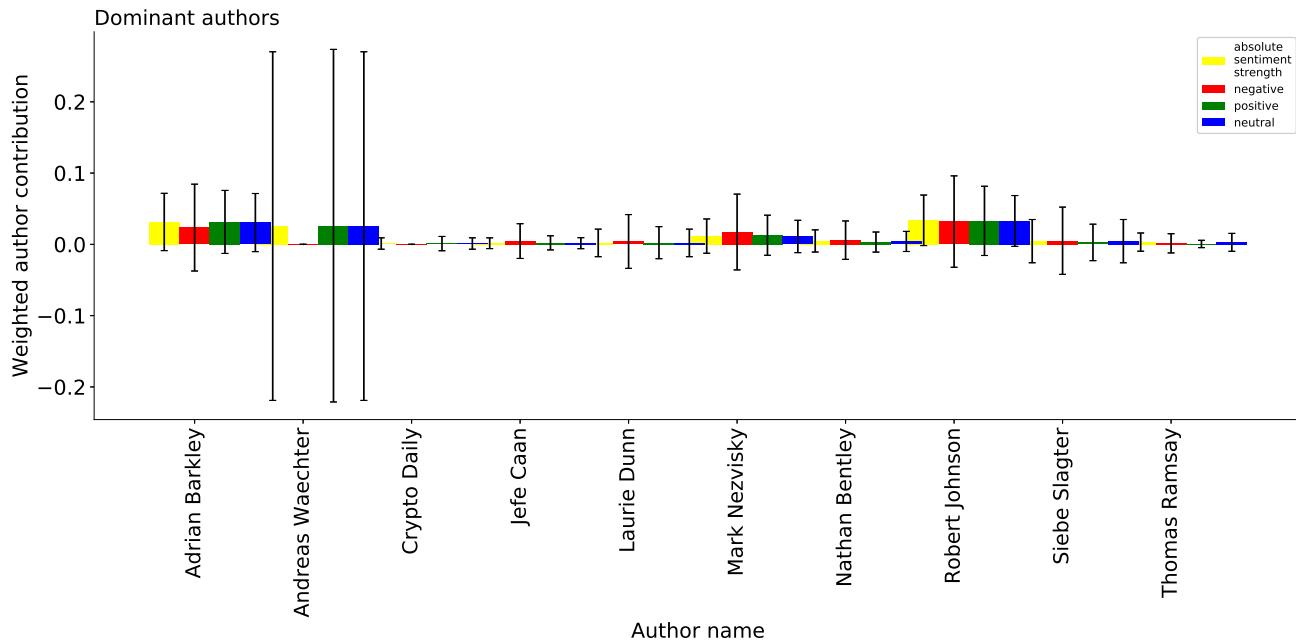


Figure 53. Main contributing authors and their sentiment tendencies for Cryptodaily articles on TRX, estimated using Algorithm 3.

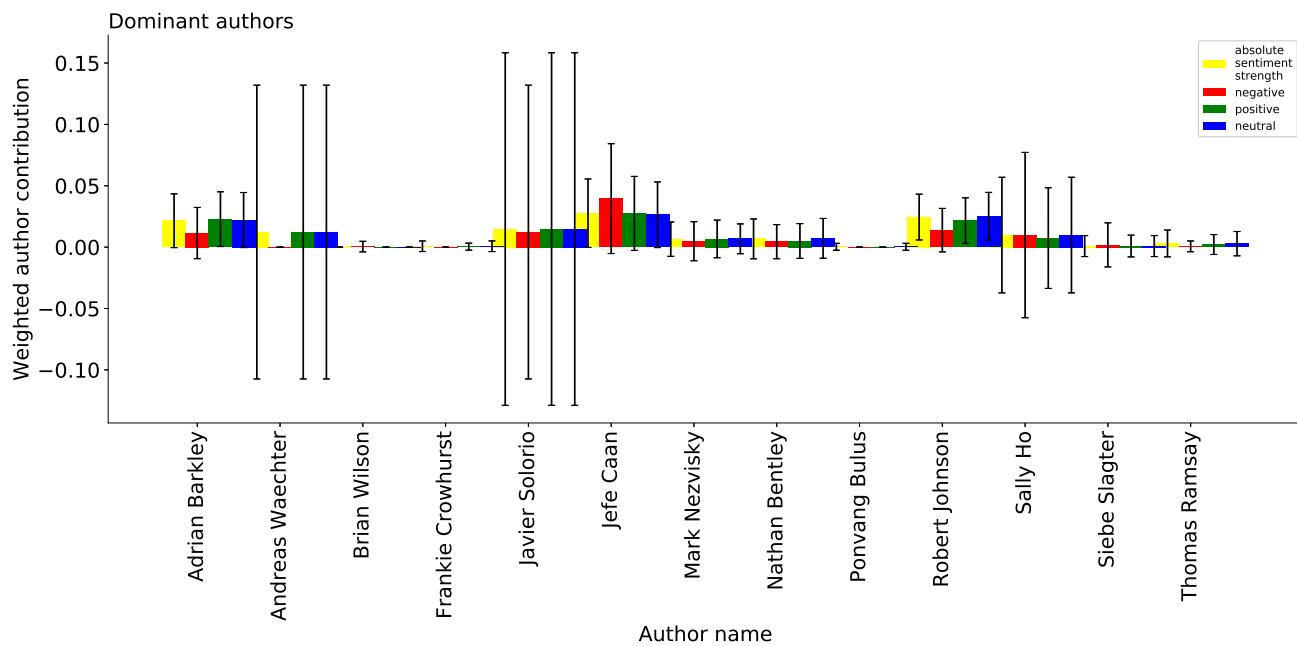


Figure 54. Main contributing authors and their sentiment tendencies for Cryptodaily articles on XRP, estimated using Algorithm 3.

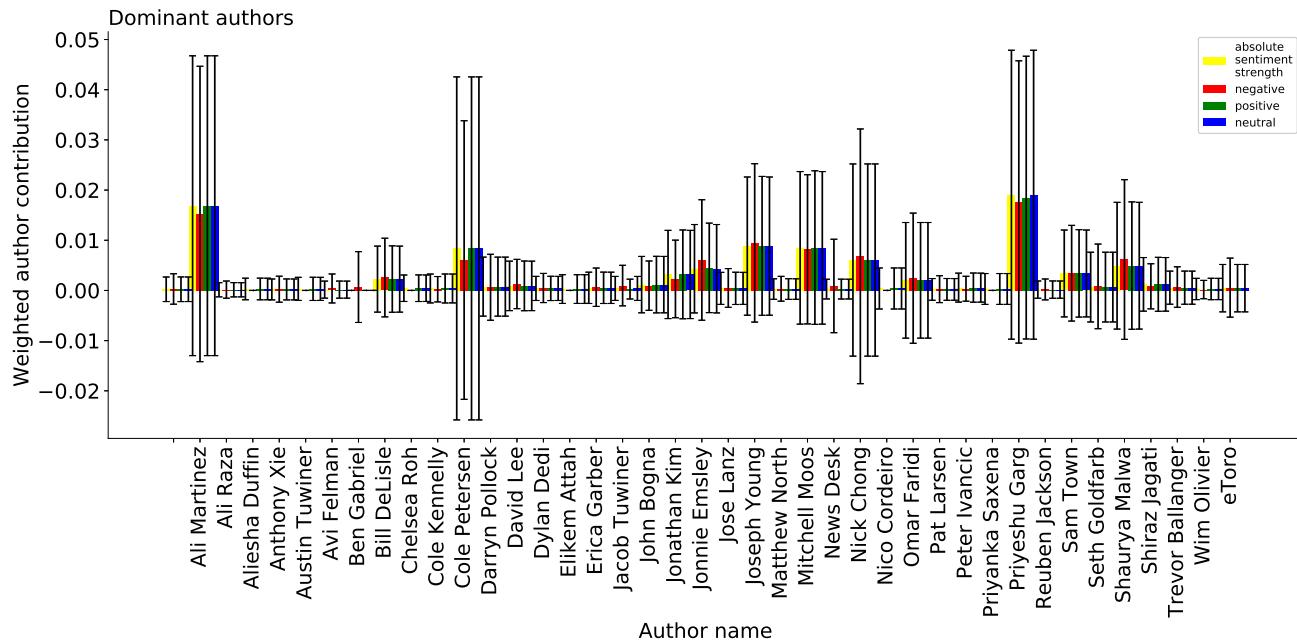


Figure 55. Main contributing authors and their sentiment tendencies for Cryptoslate articles on BTC, estimated using Algorithm 3.

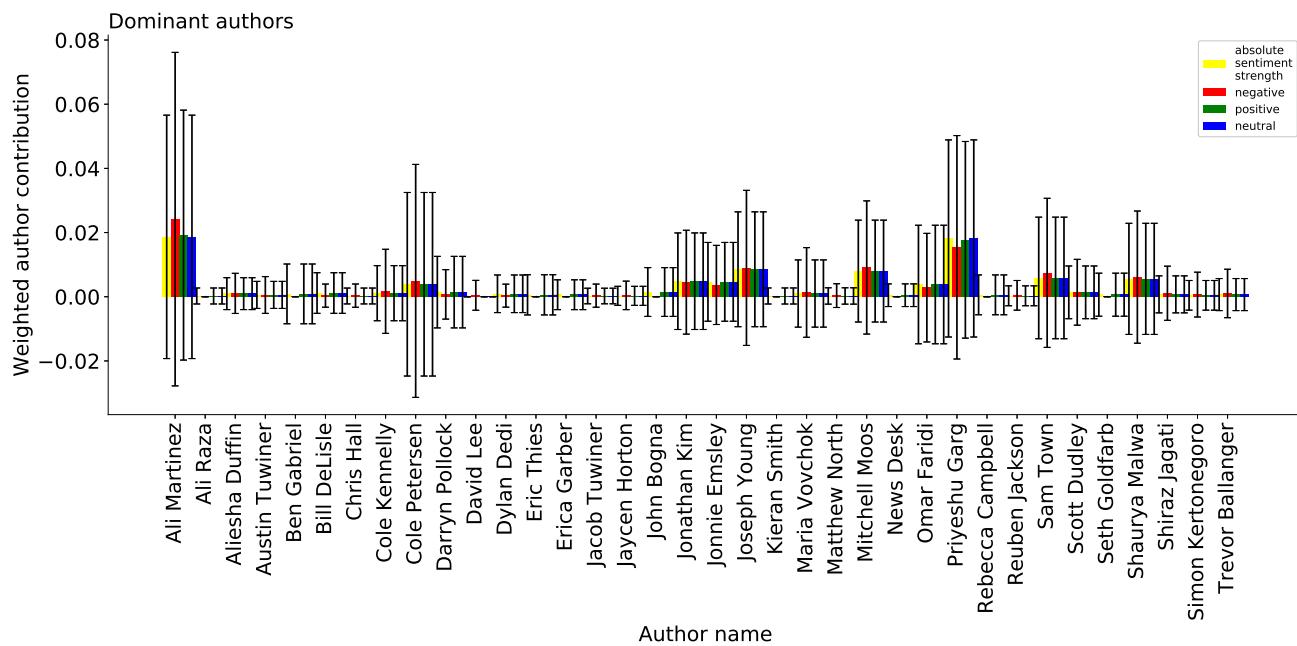


Figure 56. Main contributing authors and their sentiment tendencies for Cryptoslate articles on ETH, estimated using Algorithm 3.

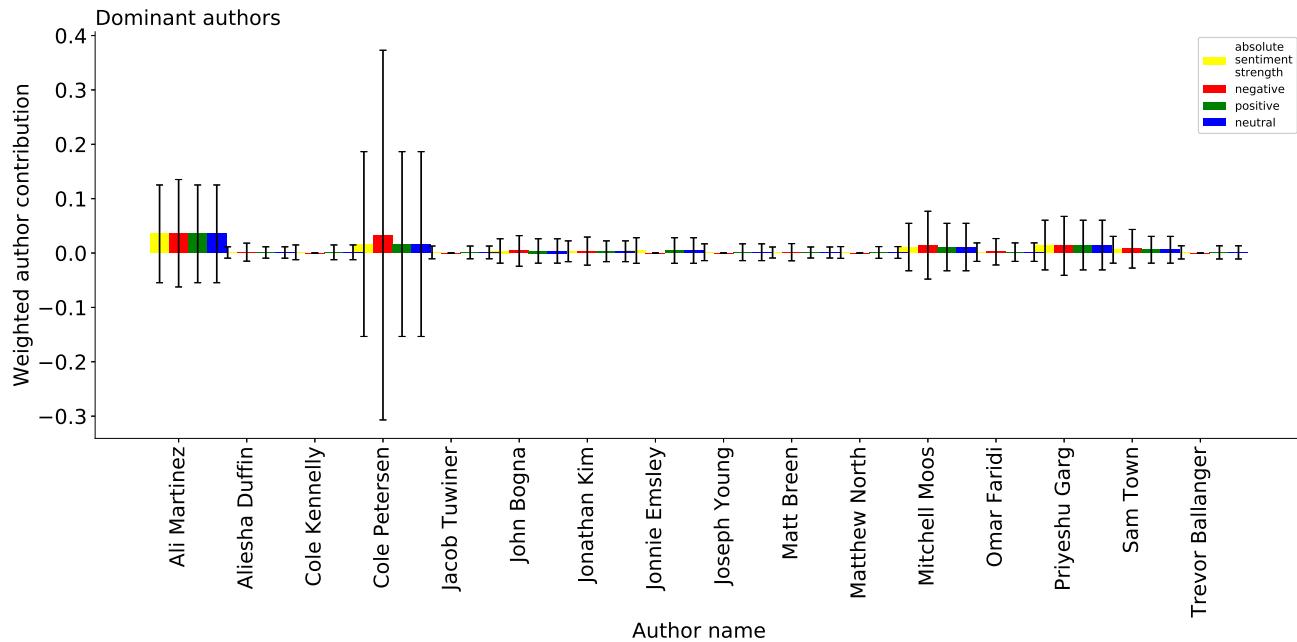


Figure 57. Main contributing authors and their sentiment tendencies for Cryptoslate articles on LTC, estimated using Algorithm 3.

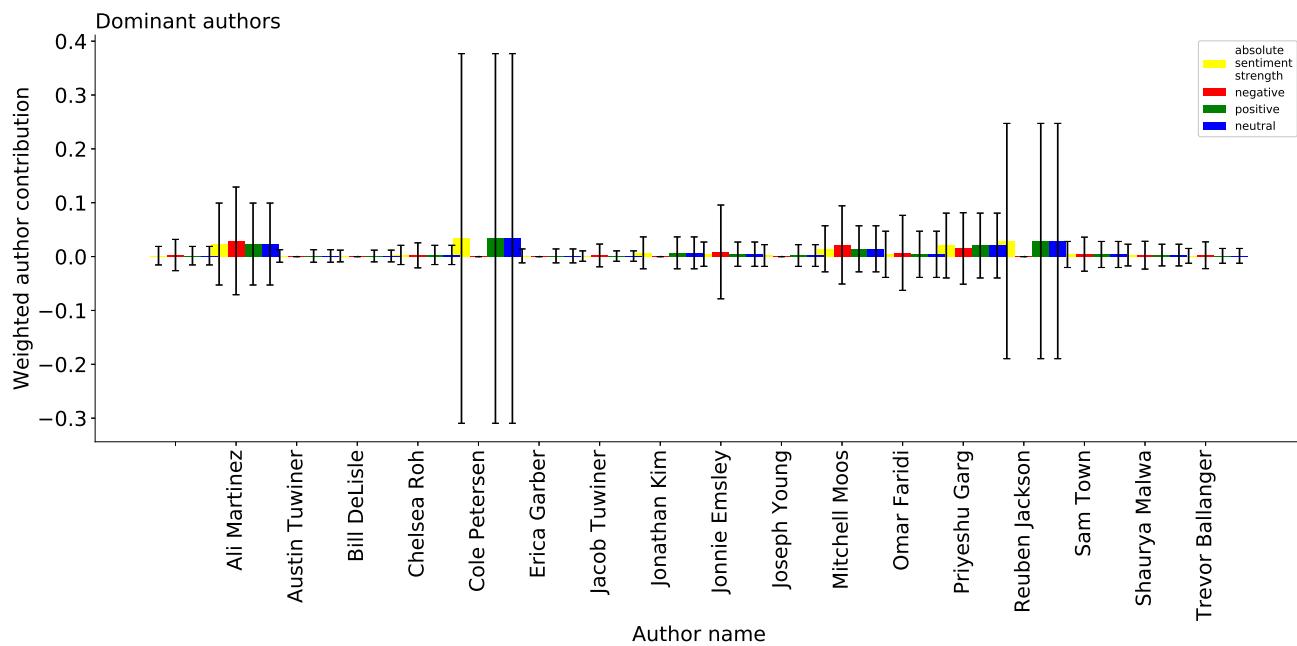


Figure 58. Main contributing authors and their sentiment tendencies for Cryptoslate articles on TRX, estimated using Algorithm 3.

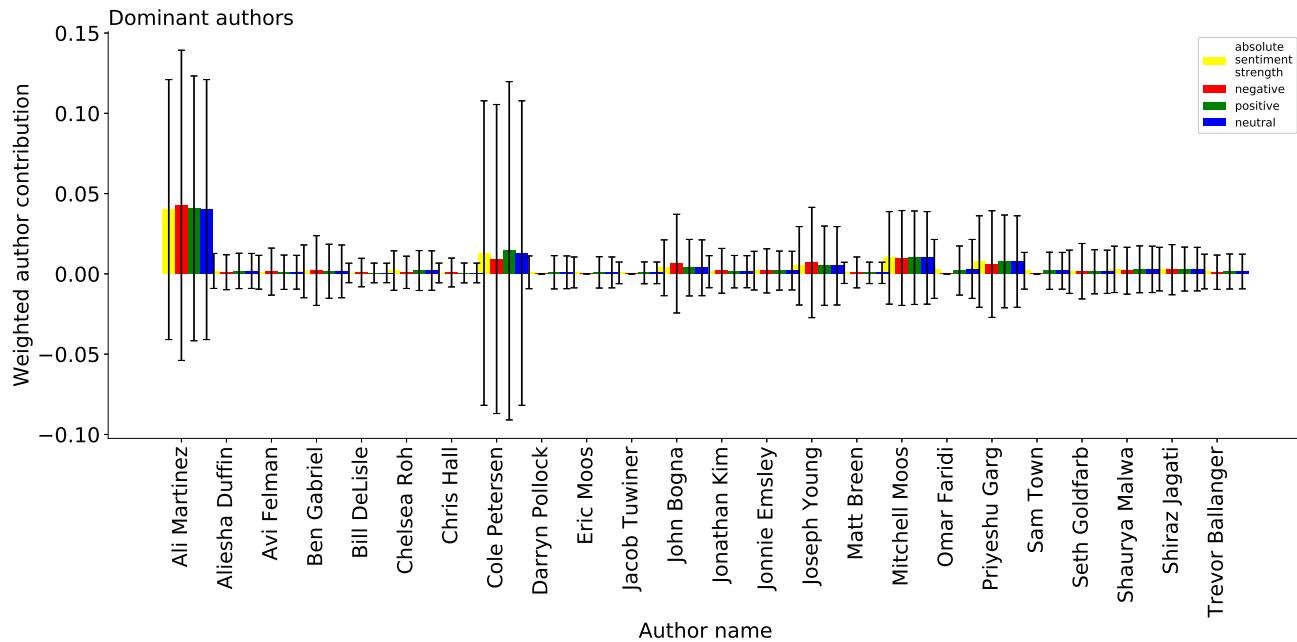


Figure 59. Main contributing authors and their sentiment tendencies for Cryptoslate articles on XRP, estimated using Algorithm 3.

5.3. Assets and reporting bias

Finally, we decompose the sentiment indices in terms of the sentiment bias of the different news sources. We summarise the values of the sentiment time-series after we partition them in yearly quarters and construct the plots in Figures 60 - 67. The median summary corresponds to the sentiment tendency over the corresponding period, whereas the IQR corresponds to the sentiment volatility.

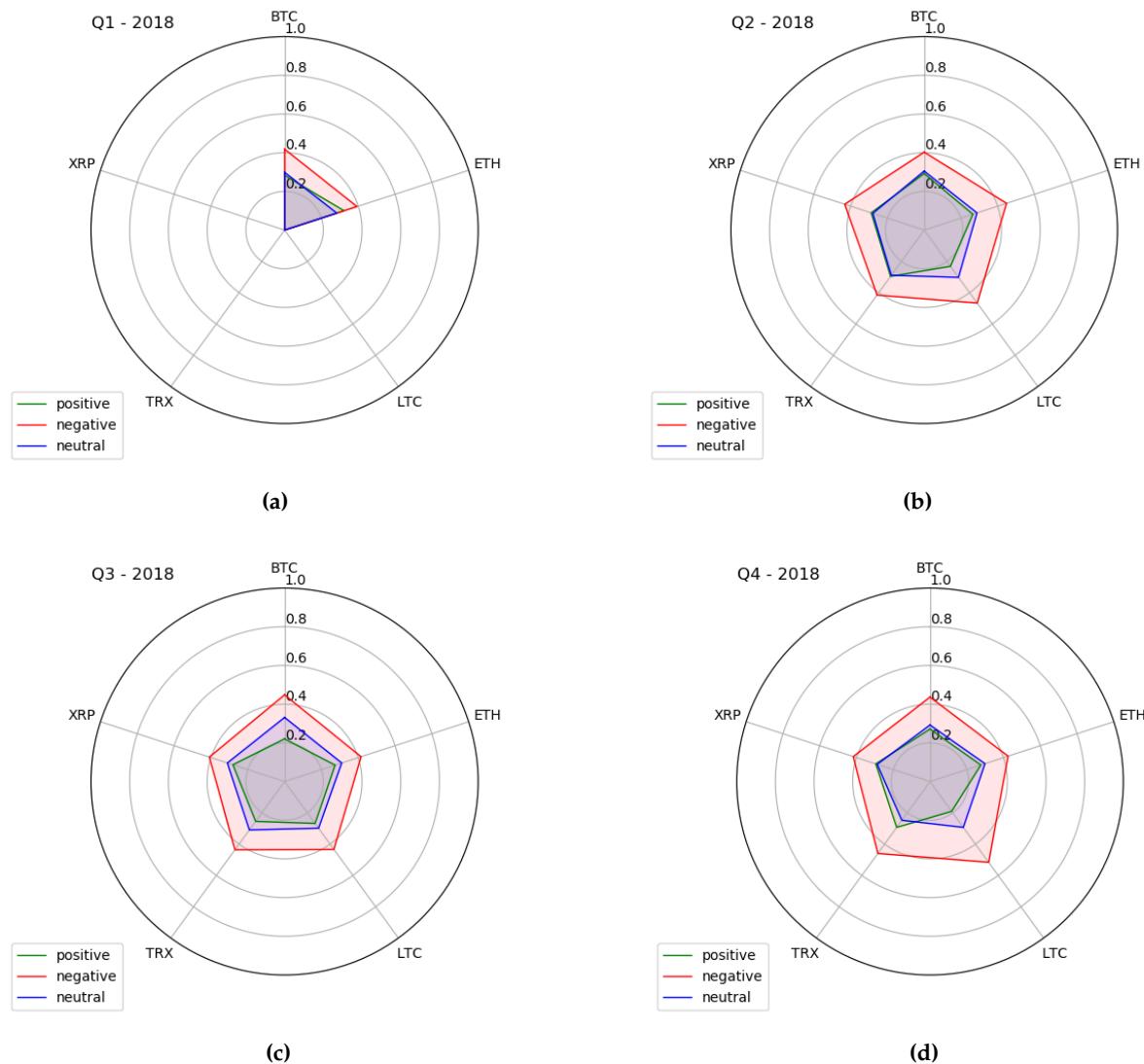


Figure 60. Cryptodaily sentiment tendencies (median)

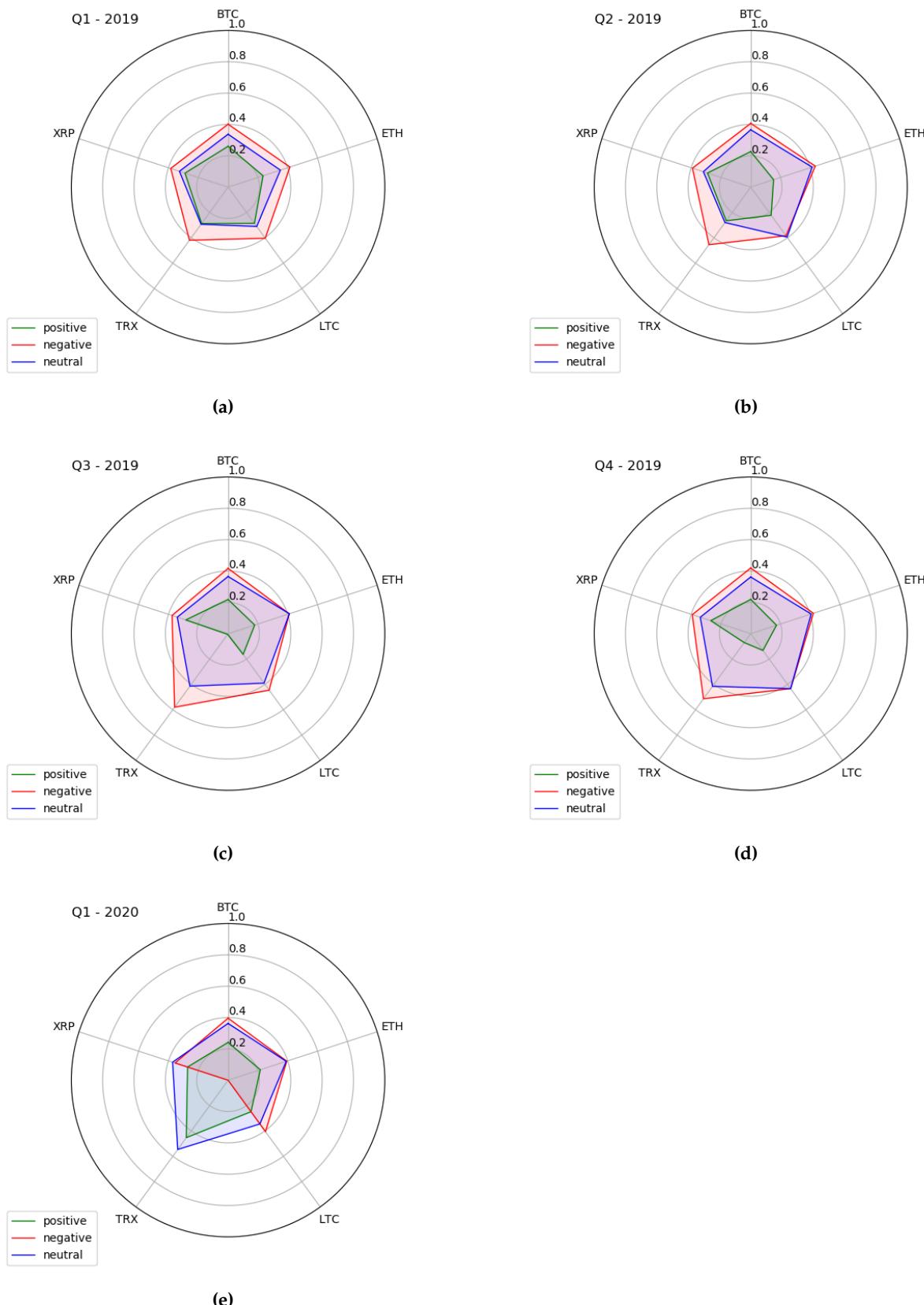


Figure 61. Cryptodaily sentiment tendencies (median)

5 INTERPRETATION OF SENTIMENT INDICES

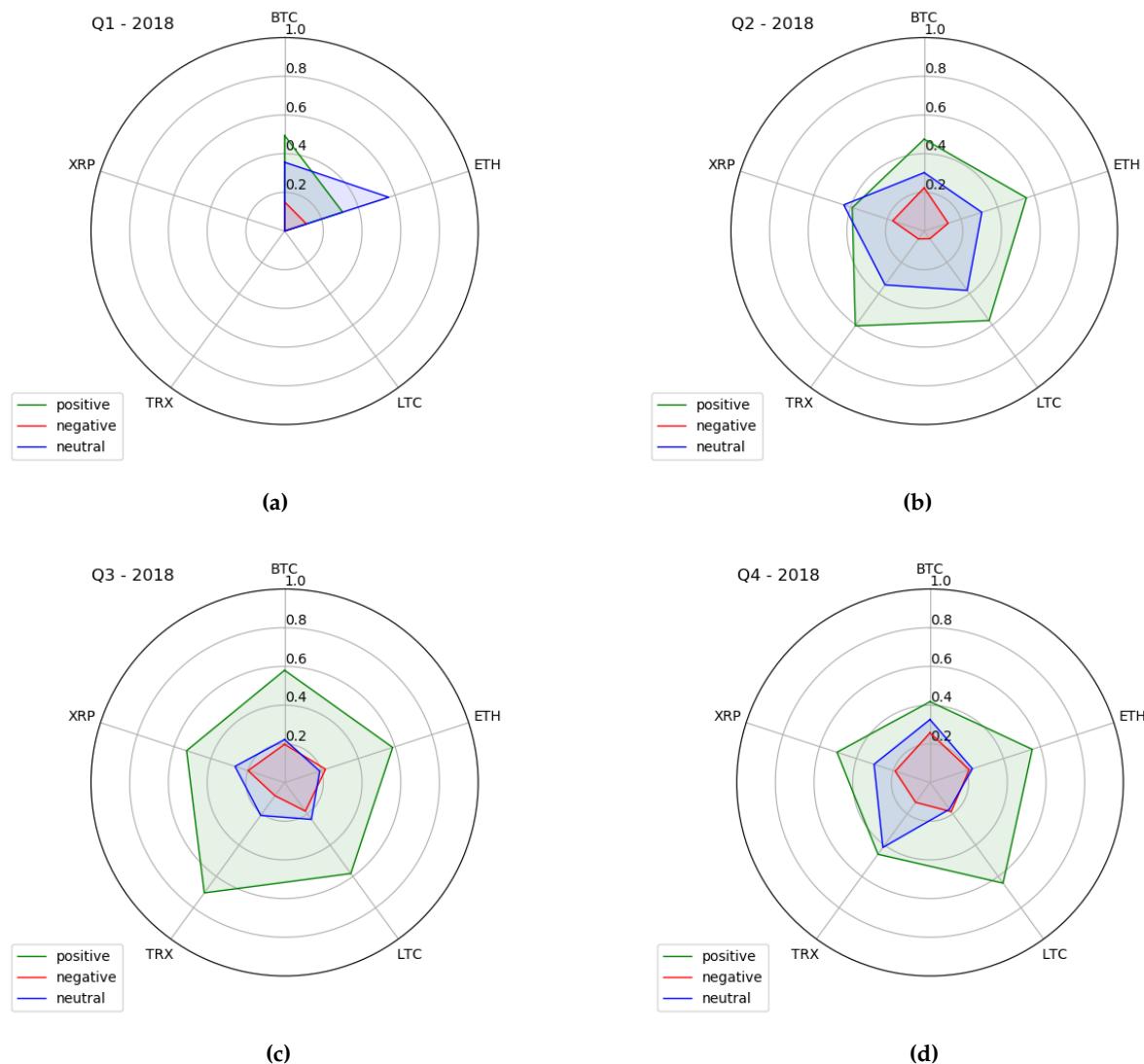


Figure 62. Cryptodaily sentiment volatility (IQR)

5 INTERPRETATION OF SENTIMENT INDICES

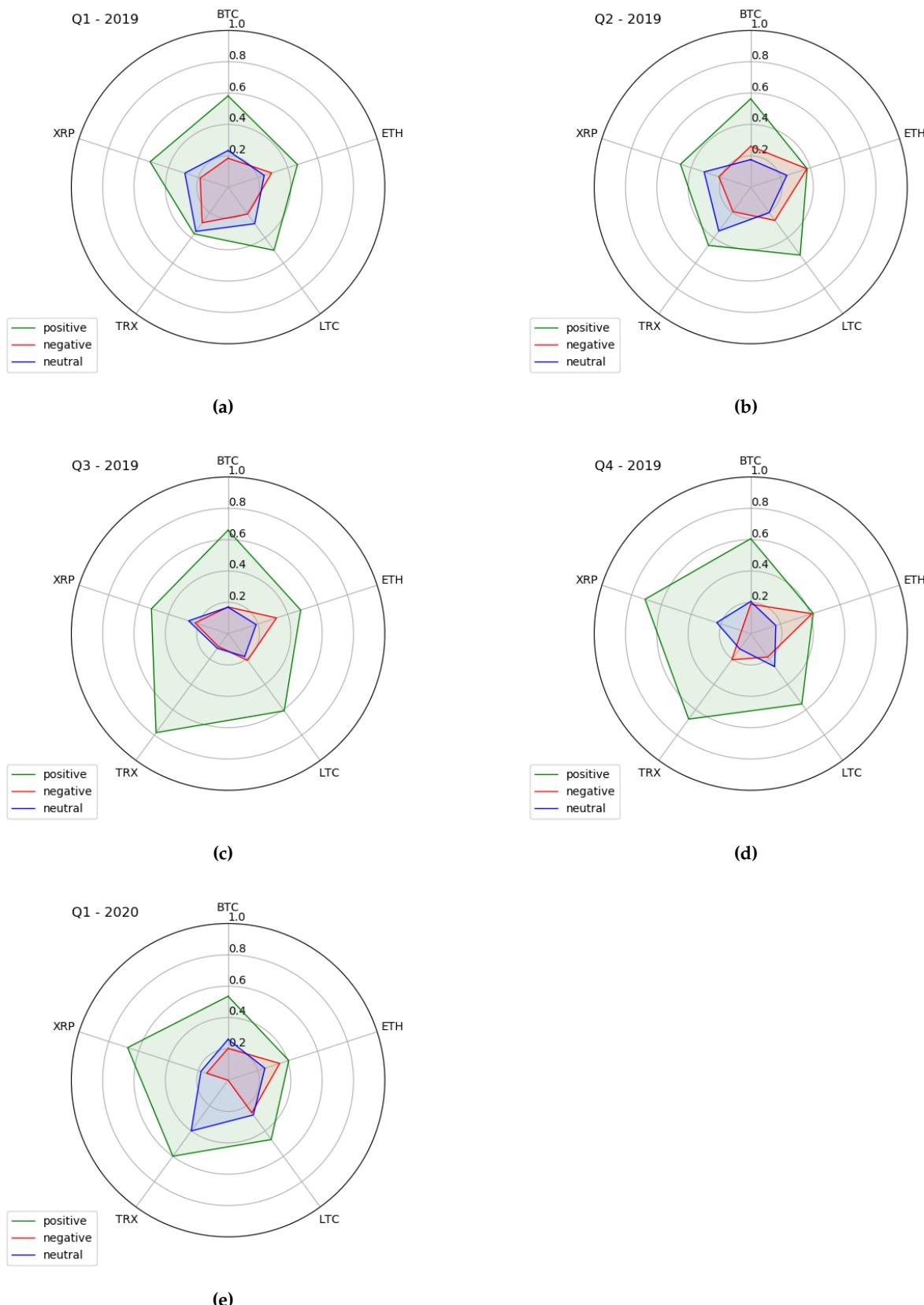


Figure 63. Cryptodaily sentiment volatility (IQR)

5 INTERPRETATION OF SENTIMENT INDICES

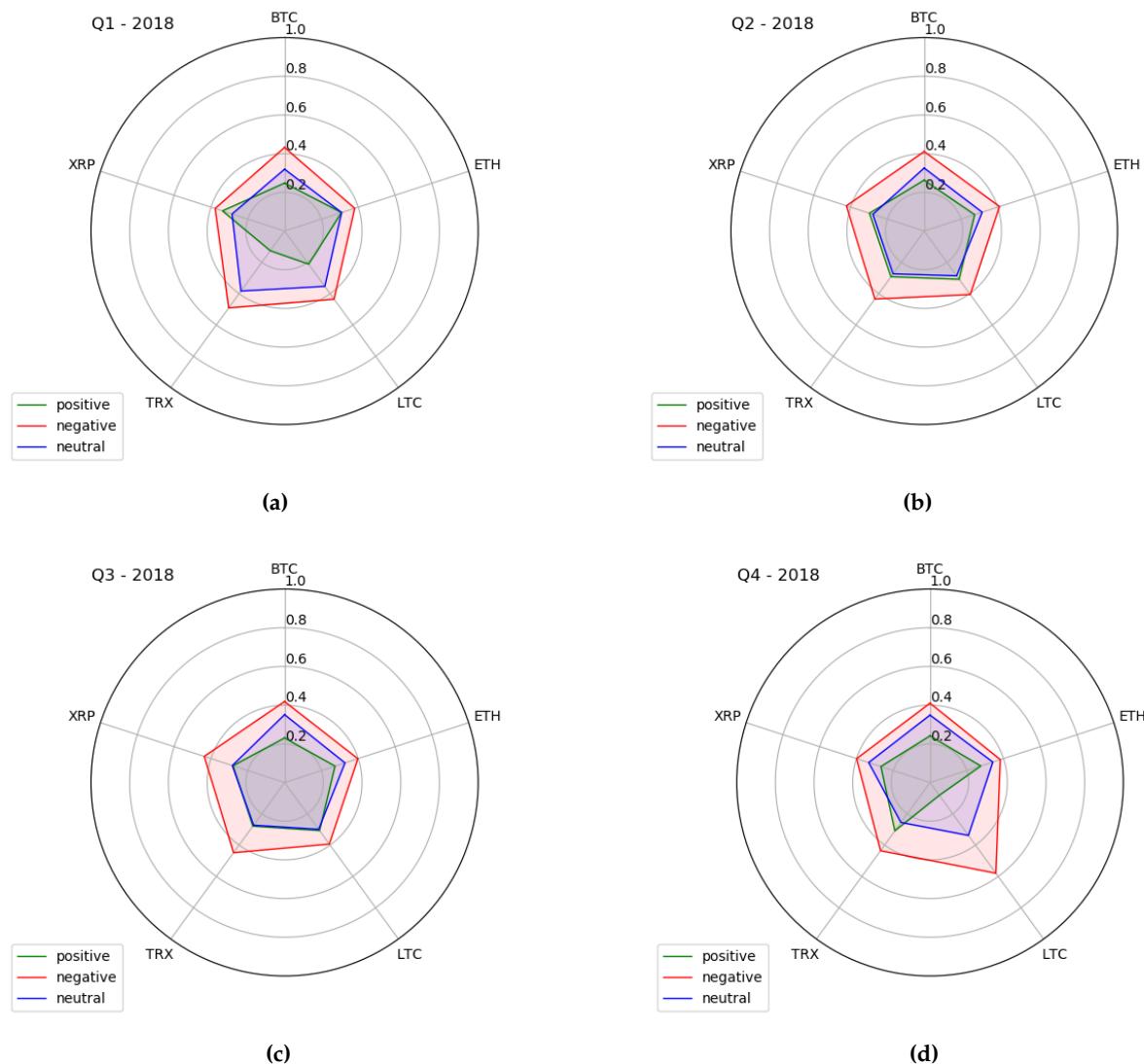


Figure 64. Cryptoslate sentiment tendencies (median)

5 INTERPRETATION OF SENTIMENT INDICES

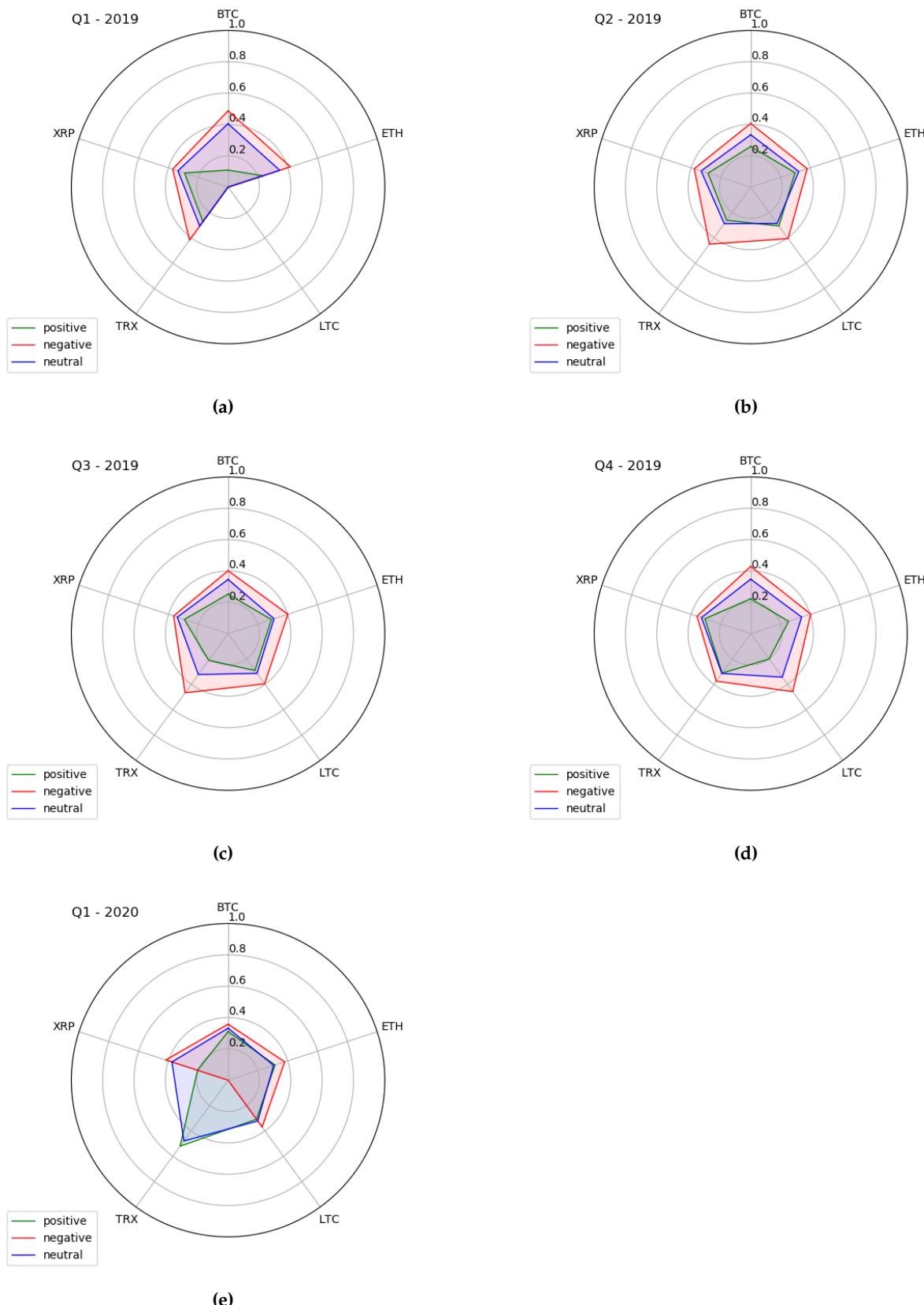


Figure 65. Cryptoslate sentiment tendencies (median)

5 INTERPRETATION OF SENTIMENT INDICES

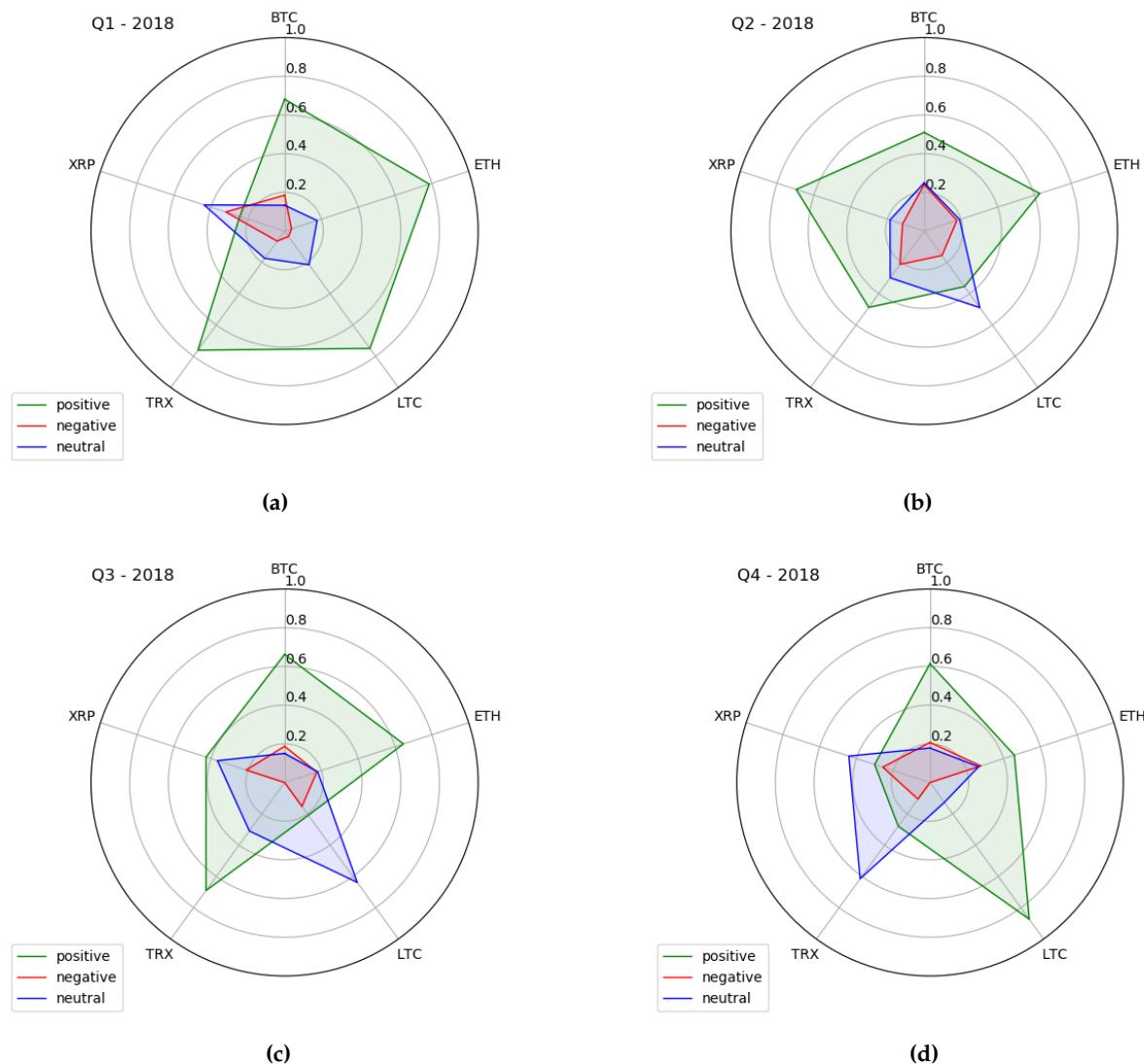


Figure 66. Cryptoslate sentiment volatility (IQR)

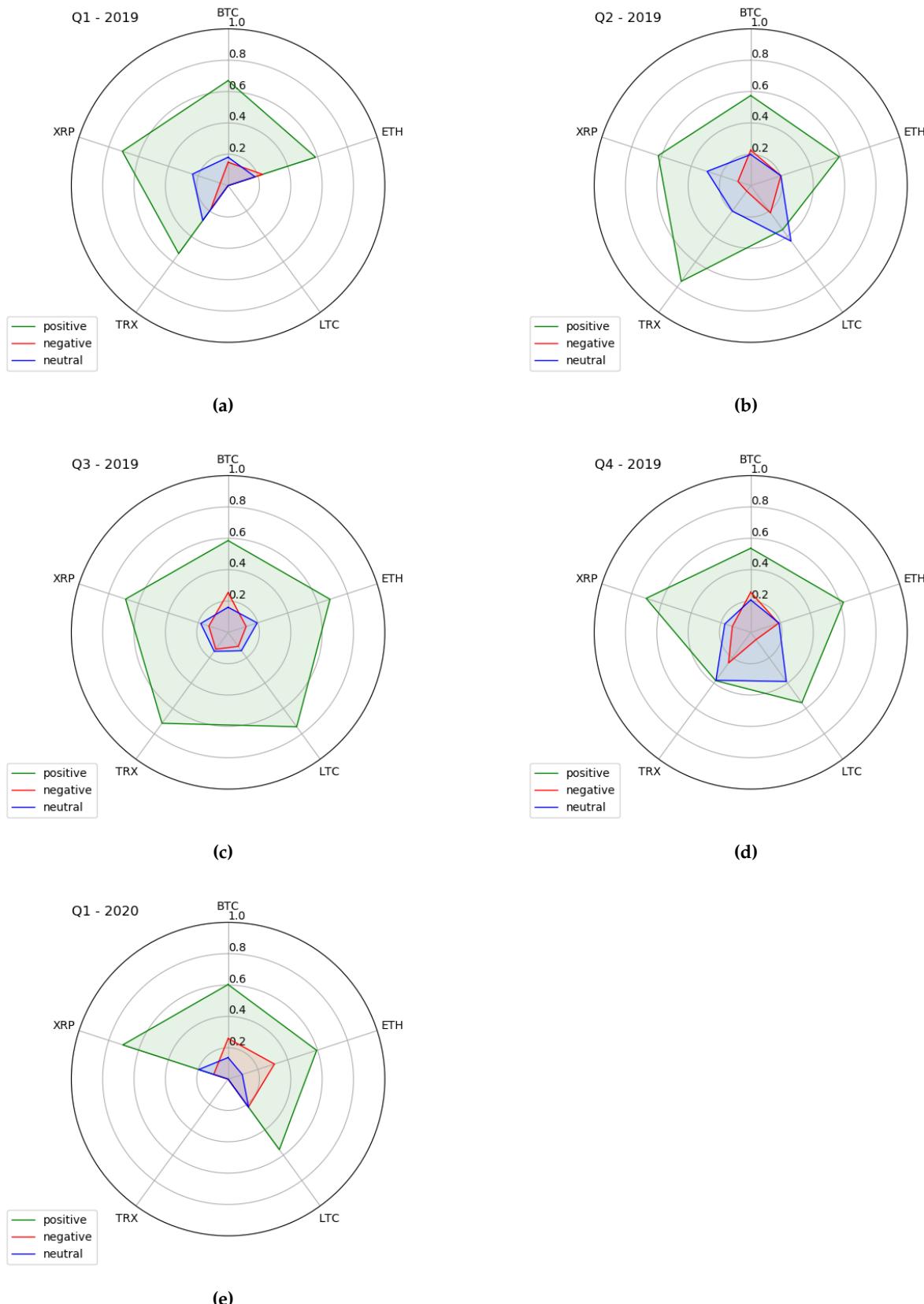


Figure 67. Cryptoslate sentiment volatility (IQR)

6. Multiple-Output GP with long memory filters: long memory definitions and estimation

The class of filters we use in this work are filters h that capture the long memory structure of each input process. To facilitate estimation, we set $h_X = h_Y = h^d$ where:

$$h^{(d)}(k) = \sum_{j=0}^{\infty} \psi_j^{(d,u)} \delta(k-j), \quad (5)$$

where $|u| < 1$, $\psi_j^{(d,u)}$ denote the coefficients of the generating function for the Gegenbauer polynomials $(1 - 2uB + B^2)^{-d}$ Stein and Weiss (1971), and are as follows:

$$\psi_j^{(d,u)} = \sum_{q=0}^{[j/2]} \frac{(-1)^q (2u)^{j-2q} \Gamma(d-q+j)}{q!(j-2q)!\Gamma(d)},$$

where $\Gamma(\cdot)$ is the Gamma function and $[j/2]$ denotes the integral part of $j/2$. In practice, one can compute the coefficients $\psi_j^{(d,u)}$ according to the following formula Yan et al. (2017):

$$\psi_j^{(d,u)} = 2u \left(\frac{d-1}{j} + 1 \right) \psi_{j-1}^{(d,u)} - \left(2 \frac{d-1}{j} + 1 \right) \psi_{j-2}^{(d,u)},$$

with the first three terms being $\psi(0) = 1$, $\psi(1) = 2du$ and $\psi(2) = -d + 2d(1+d)u^2$.

Then we can compute the covariance between two processes X_t, Y_t as follows:

$$\begin{aligned} \text{cov}(X_t, Y_s) &= \text{cov}(u^X(t), u^Y(s)) \\ &= \sigma_{u_0}^2 \sum_{\tau=-\infty}^{+\infty} h^{(d)}(\tau) h^{(d)}(s-t+\tau) \\ &= \sigma_{u_0}^2 \sum_{\tau=-\infty}^{+\infty} \sum_{j=0}^{+\infty} \psi_j^{(d,u)} \delta(\tau-j) \sum_{k=0}^{+\infty} \psi_k^{(d,u)} \delta(s-t+\tau-k) \\ &= \sigma_{u_0}^2 \sum_{j=0}^{+\infty} \sum_{k=0}^{+\infty} \psi_j^{(d,u)} \psi_k^{(d,u)} \sum_{\tau=-\infty}^{+\infty} \delta(\tau-j) \delta(s-t+\tau-k) \\ &= \sigma_{u_0}^2 \sum_{j=0}^{+\infty} \sum_{k=0}^{+\infty} \psi_j^{(d,u)} \psi_k^{(d,u)} \delta(s-t+j-k). \end{aligned} \quad (6)$$

6.1. Estimation of filter parameter d from time-series data

We assume the ARFIMA($0, d, 0$) type of long memory, i.e. we set $u = 1$, and only have to estimate d , namely the long memory exponent. Given a stationary time series process $\mathbf{Y} \equiv \{Y_t\}_{t=1:T}$ we say that Y_t is a long memory stationary process if the following condition (Beran 1994) holds in terms of the divergence of the autocorrelation function for Y_t and Y_{t+j} at lag j :

$$\lim_{n \rightarrow \infty} \sum_{j=-n}^n |\rho(j)| \rightarrow \infty, \quad (7)$$

where

$$\rho(j) = \frac{\text{Cov}(Y_t, Y_{t+j})}{\sqrt{\text{Var}(Y_t) \text{Var}(Y_{t+j})}} \quad (8)$$

A number of estimators of long memory d , or the Hurst exponent H [Hurst \(1951\)](#), which is closely related to long memory via $d = H - 0.5$, have been proposed and studied in literature.

The first Hurst exponent estimator to measure the intensity of long-range dependence in a time-series, was developed by [Hurst \(1951\)](#) in the Rescaled Range R/S analysis. Given a time series $Y_{t \in \{1, 2, 3, \dots, T\}}$, the sample mean and the standard deviation process are given by

$$\bar{Y}_T = \frac{1}{T} \sum_{j=1}^T Y_j \text{ and } S_t = \sqrt{\frac{1}{t-1} \sum_{j=1}^t (X_j)^2}, \quad (9)$$

where $X_t = Y_t - \bar{Y}_T$ is the mean-adjusted series. Then a cumulative sum series is given by $Z_t = \sum_{j=1}^t X_j$ and the cumulative range based on these sums is

$$R_t = \text{Max}(0, Z_1, \dots, Z_t) - \text{Min}(0, Z_1, \dots, Z_t). \quad (10)$$

The following proposition proposes an estimator of H as derived in [Mandelbrot \(1975\)](#).

Proposition 1. Consider a time-series $Y_t \in \mathbb{R}$ and define S_t and R_t in Equations (9) and (10) respectively, then $\exists C \in \mathbb{R}$ such that the following asymptotic property of the Rescaled Range R/S holds

$$[R/S](T) = \frac{1}{T} \sum_{t=1}^T R_t / S_t \sim CT^H, \text{ as } T \rightarrow \infty.$$

In addition, for small sample size T , the Rescaled Range R/S can also be approximated by following equation ([Annis and Lloyd 1976](#))

$$[R/S](T) = \begin{cases} \frac{T-1/2}{T} \frac{\Gamma((T-1)/2)}{\sqrt{\pi(T/2)}} \sum_{j=1}^{T-1} \sqrt{\frac{T-j}{j}}, & \text{for } T \leq 340 \\ \frac{T-1/2}{T} \frac{1}{\sqrt{T\pi/2}} \sum_{j=1}^{T-1} \sqrt{\frac{T-j}{j}}, & \text{for } T > 340 \end{cases},$$

where the $\frac{T-1/2}{T}$ term was added by [Peters \(1994\)](#). The estimate of H can then be obtained by a simple linear regression

$$\log R/S(T) = \log C + H \log T.$$

Hence, we have the following definition for \hat{H} , the estimator of H , based on the Rescaled Range R/S analysis and given by:

$$\hat{H}_{R/S} = \frac{T(\sum_{t=1}^T \log R/S(t) \log t) - (\sum_{t=1}^T \log R/S(t))(\sum_{t=1}^T \log t)}{T(\sum_{t=1}^T (\log t)^2) - (\sum_{t=1}^T \log t)^2}. \quad (11)$$

The empirical confidence interval of \hat{H} given in Equation (11) with sample size $T = 2^N$ ([Weron 2002](#)) is

$$(0.5 - \exp(-7.33 \log(\log N) + 4.21), \exp(-7.20 \log(\log N) + 4.04) + 0.5).$$

Note that no asymptotic distribution theory has been derived for the estimated Hurst parameter H for R/S analysis, however, we can apply bootstrap methods to find related properties to test for statistical significance of the estimates in order to detect the long memory properties.

7. Sentiment indices and causal evidence with convolutional structure in the model

In the current section we present the bulk of causal evidence we collected under convolutional model structure.

Figures 68 - 69 show the evidence for 3 lags (1,7, or 30 days) and 4 different strengths of long memory.

Figures 70-73 show the causal relationships between the three sentiment index constructions (NLP1, NLP2, NLP3) and BTC price, for all lags. The left plots show the causal evidence in the direction price → sentiment, and the right plots show the causal evidence sentiment → price.

Finally, we study the causal relationships between hash rate and sentiment (NLP2) under the effect of the convolutional structure. We plot the causal evidence in Figures 74 and 75 for all lags and long memory exponents of the selected grid.

We note that we do not detect significant difference in the strength or the patterns of the collected evidence as we vary the long memory strength, which is due to the convolutional kernel dominating the GP kernel in magnitude in all cases of long memory strength.

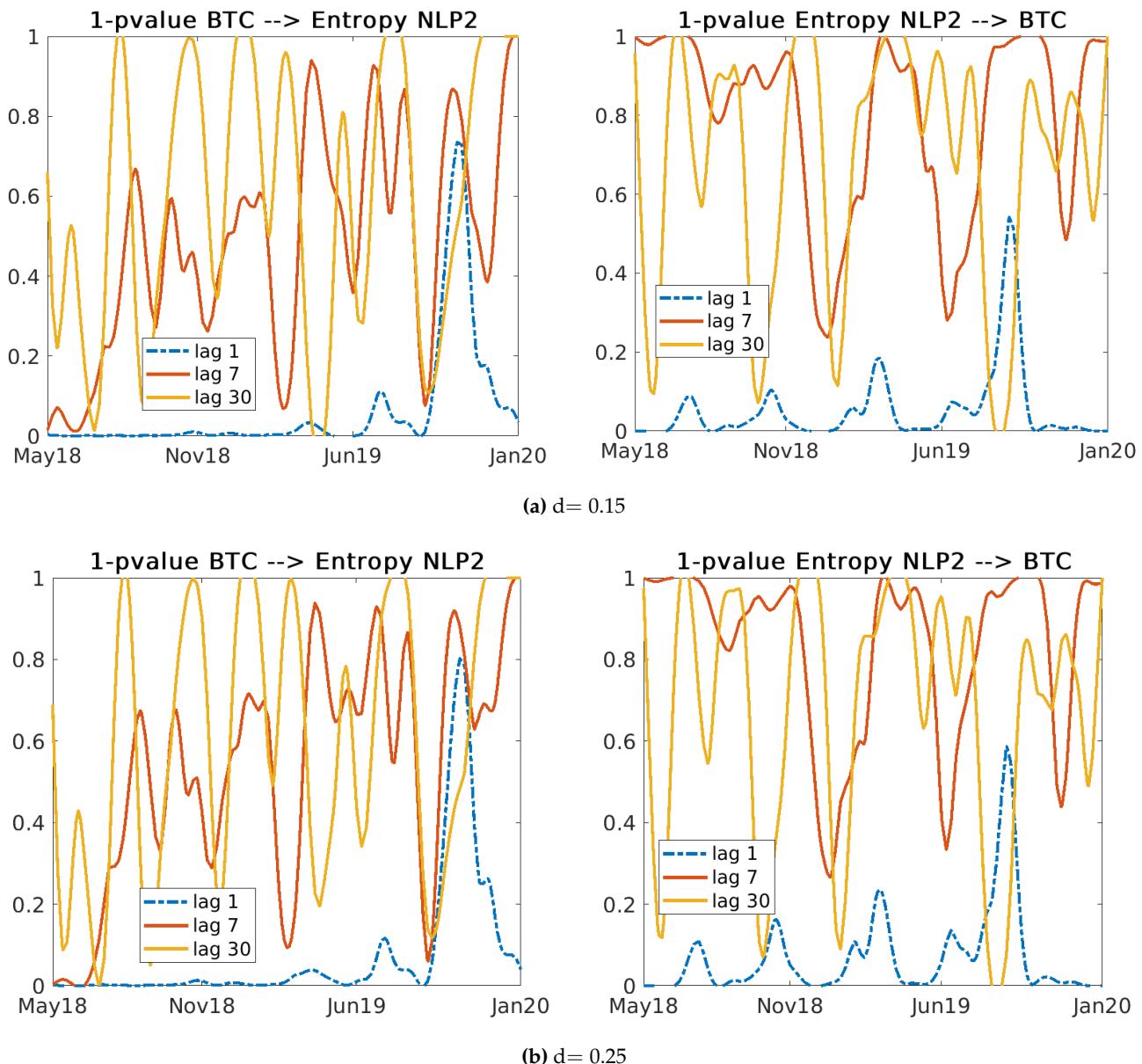


Figure 68. NLP2 (dynamic, with asset decay) sentiment index and BTC price

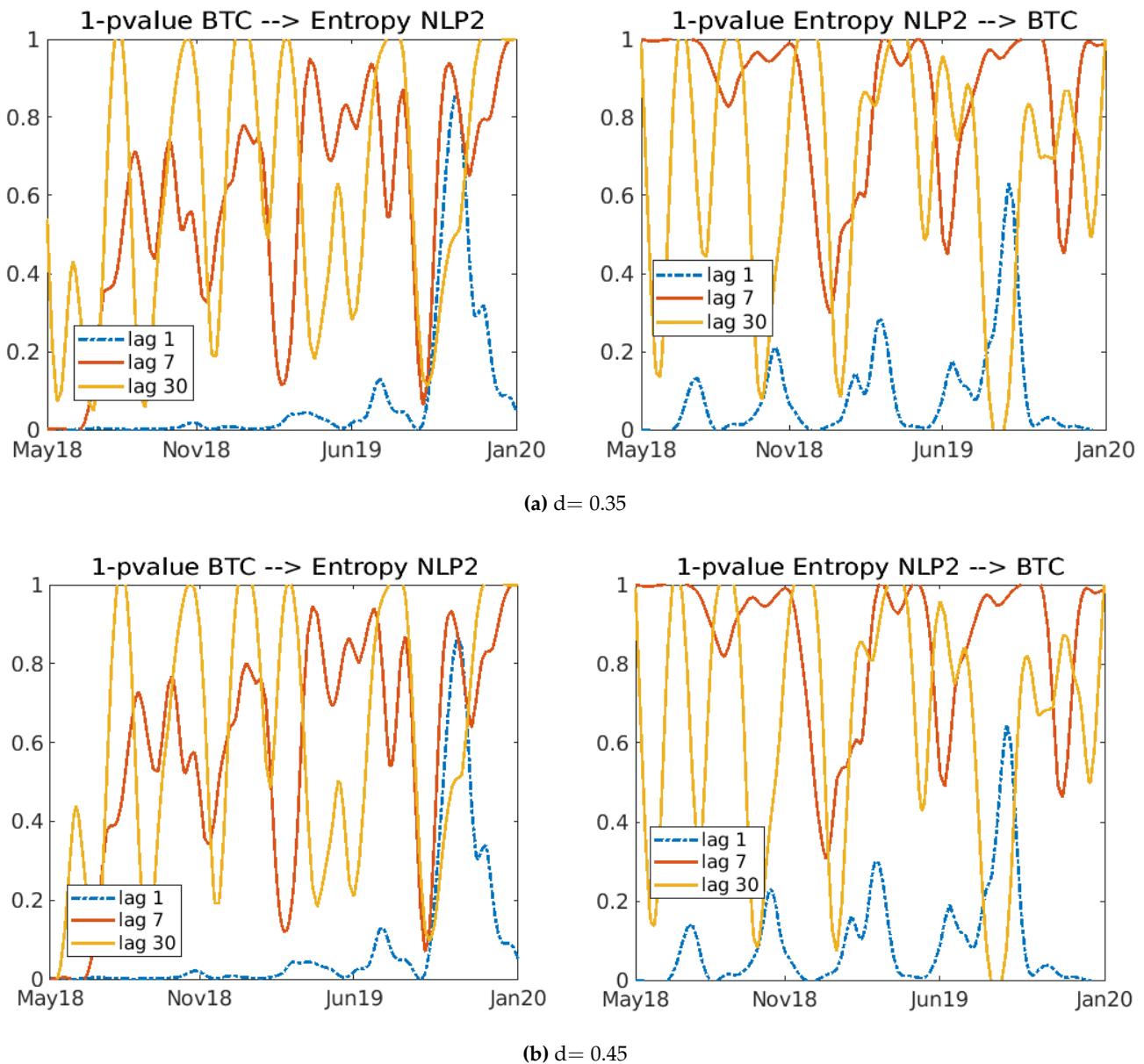
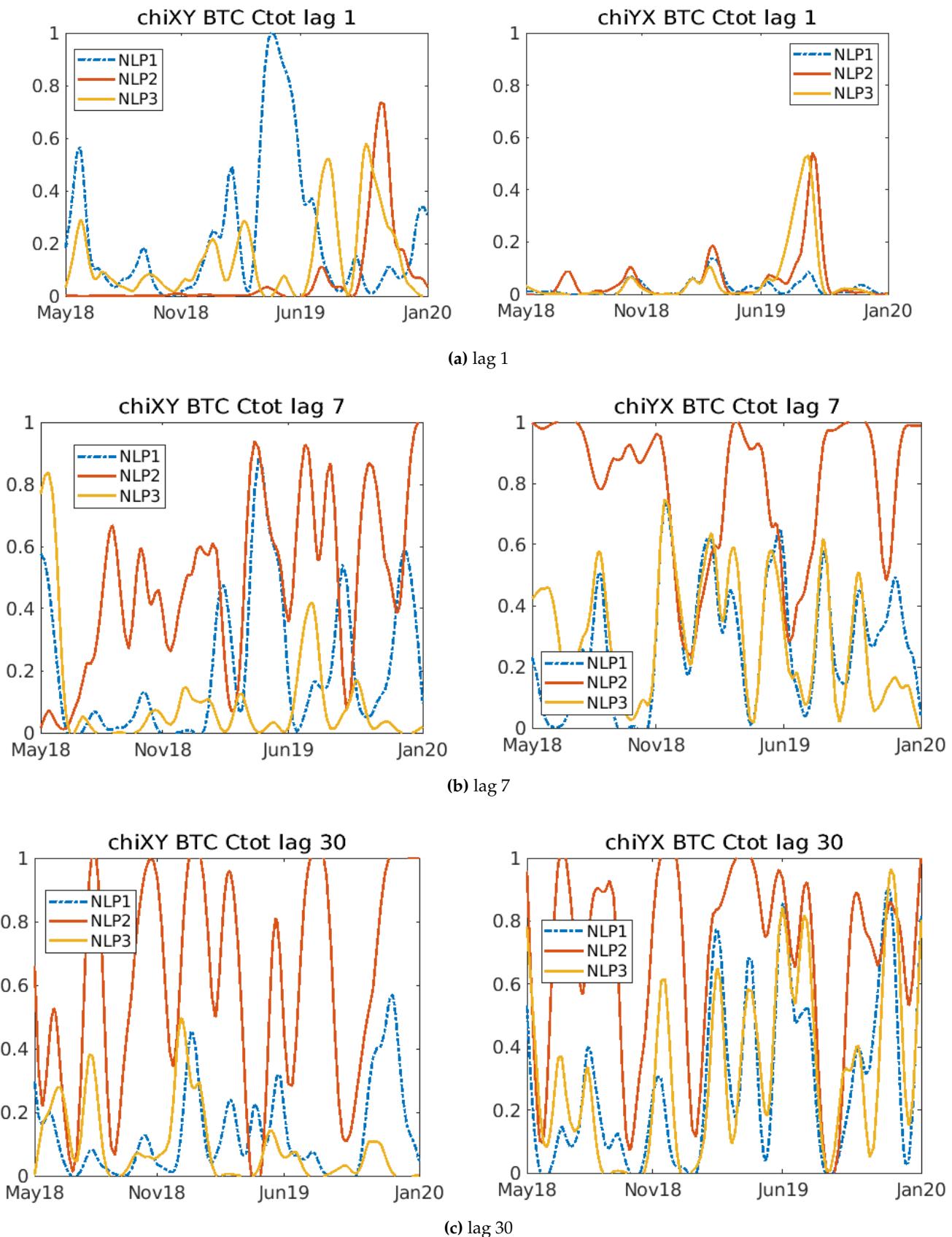
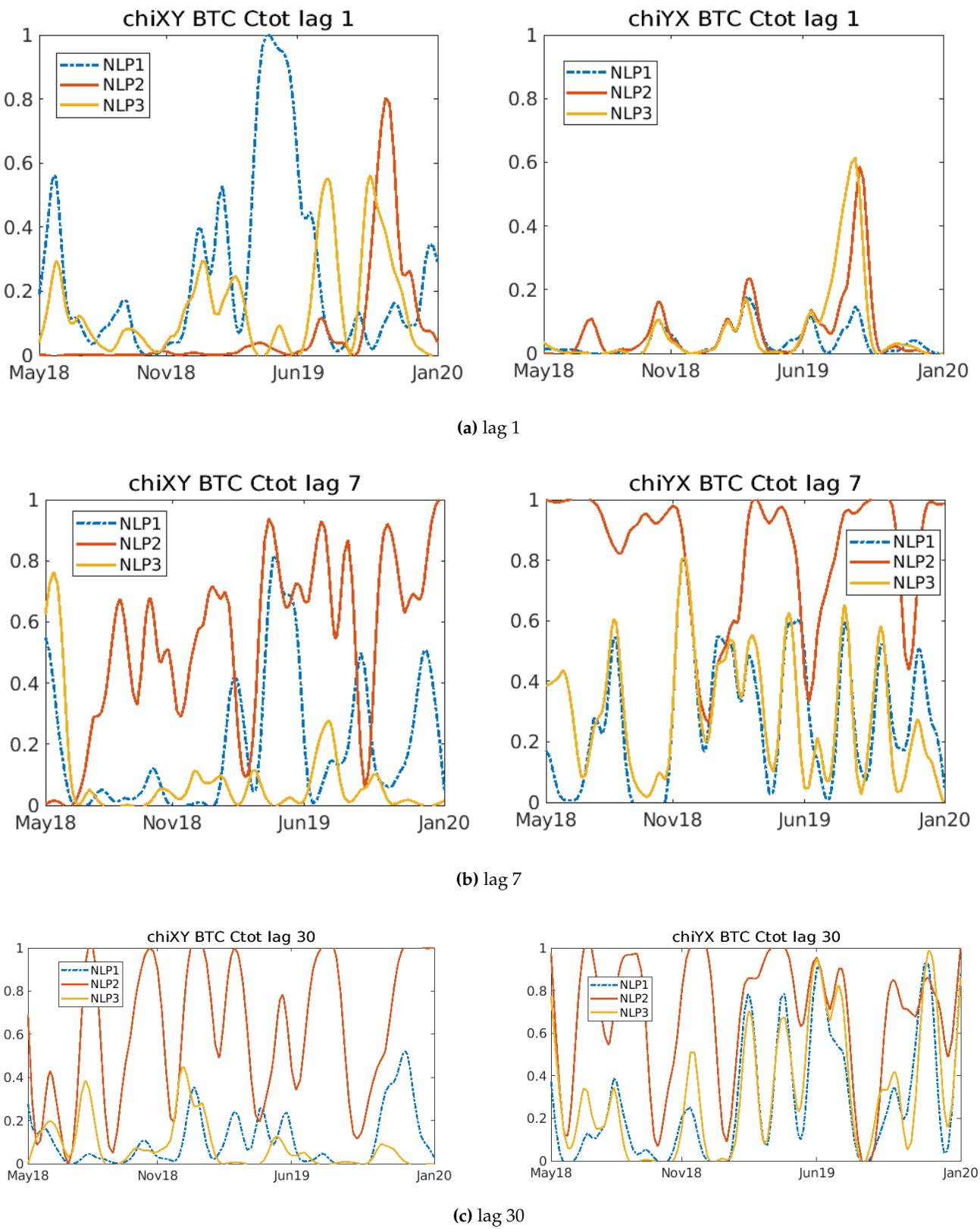
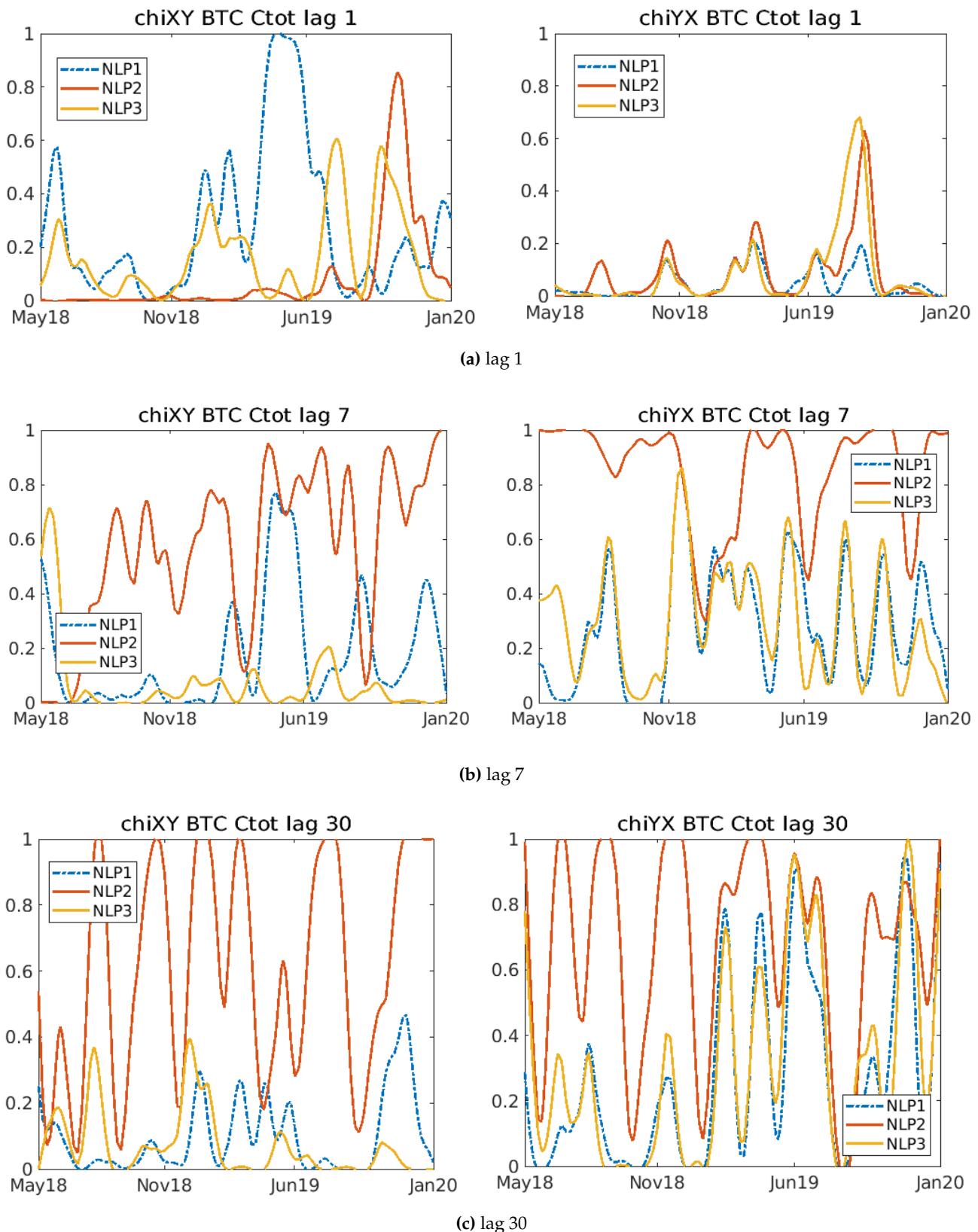
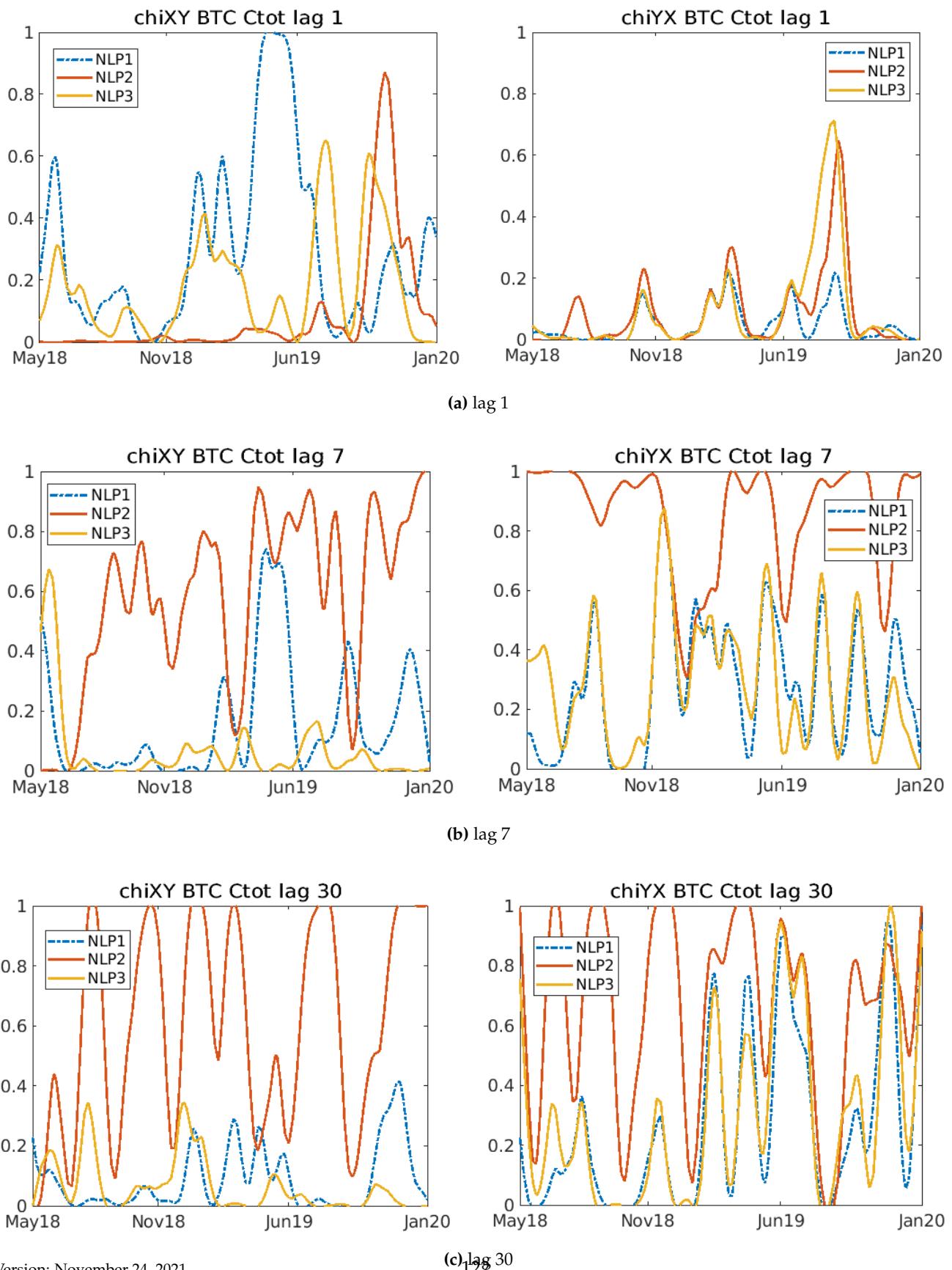


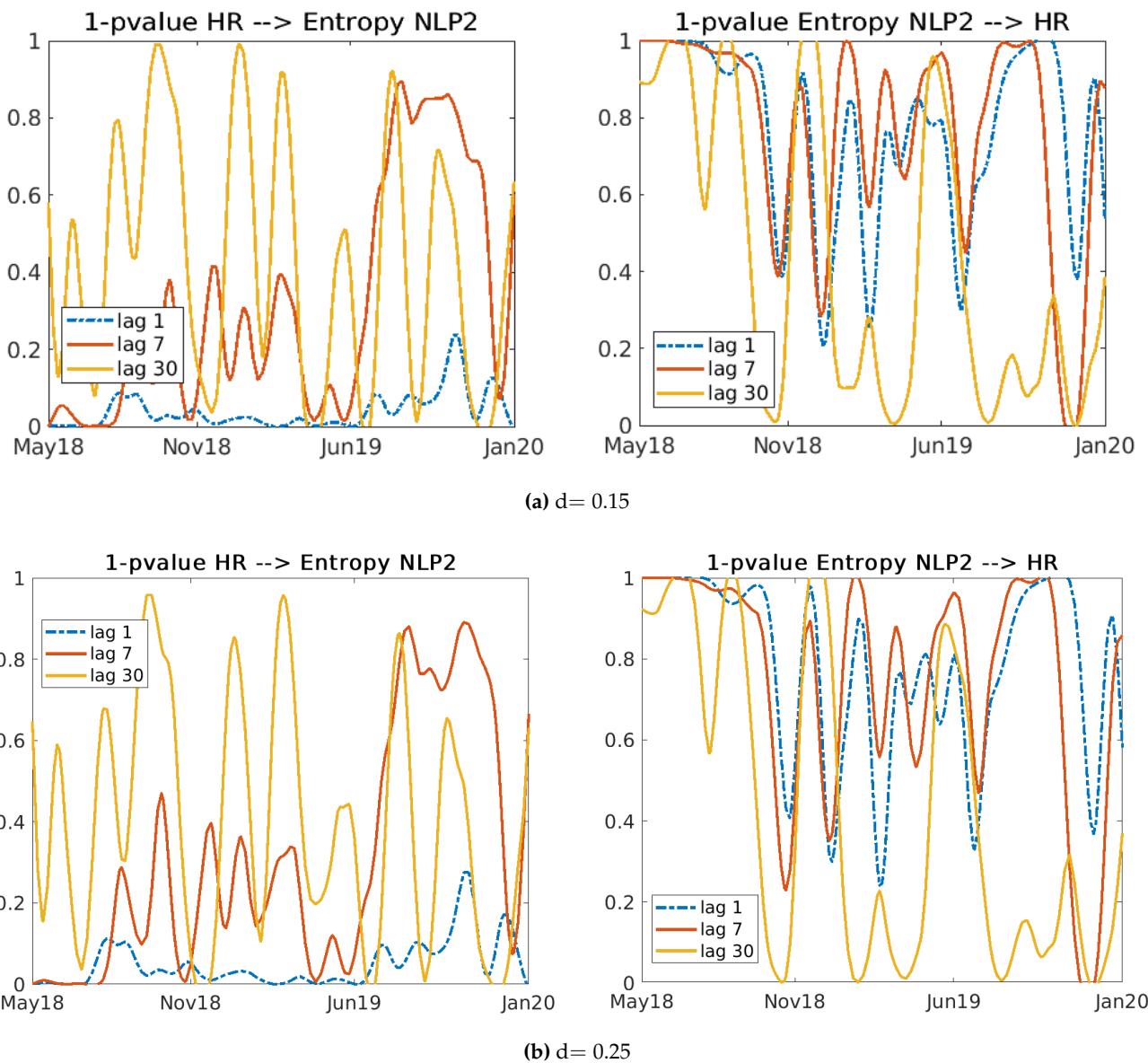
Figure 69. NLP2 (dynamic, with asset decay) sentiment index and BTC price

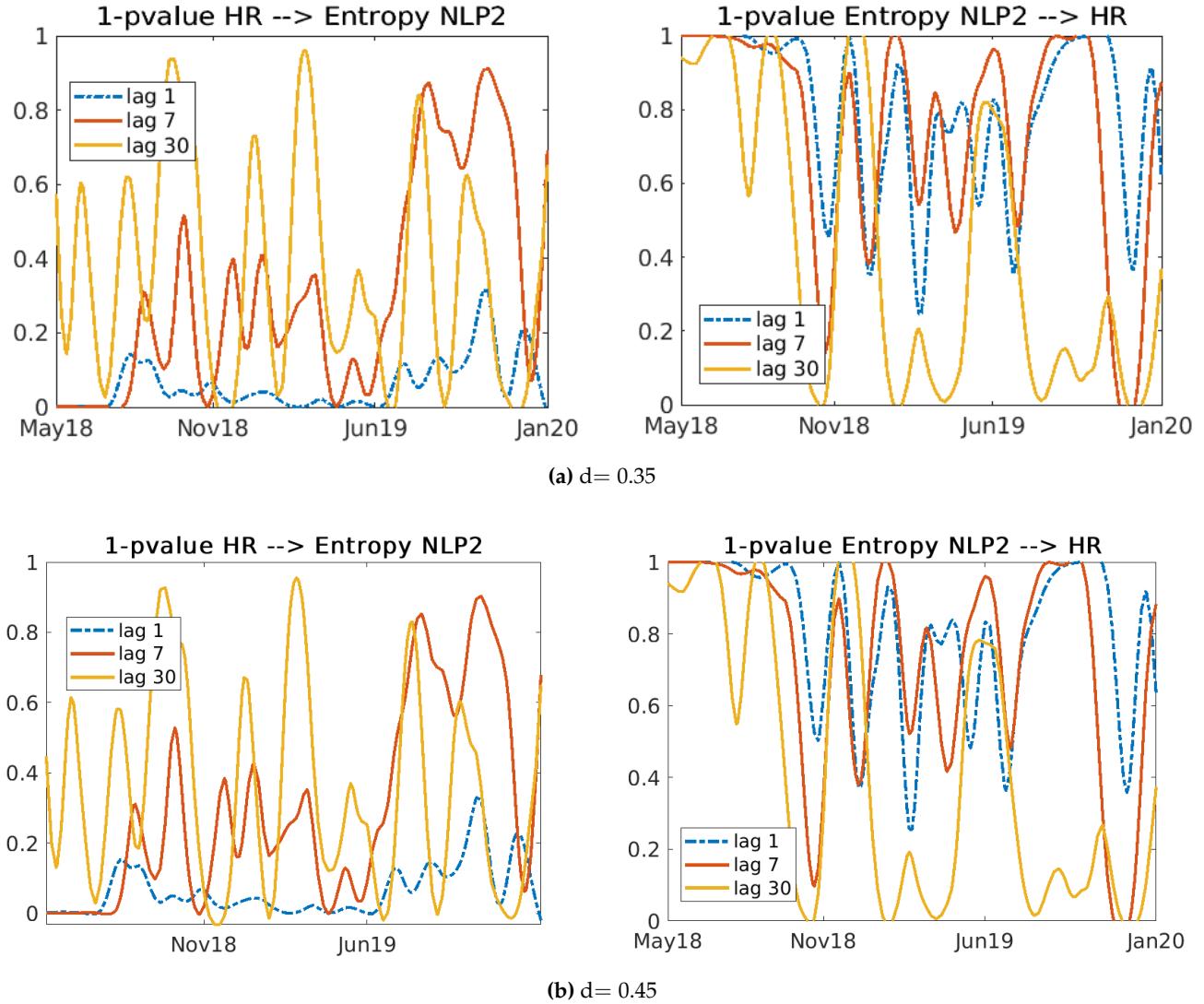


**Figure 71.** Causal relationships between sentiment indices and BTC price - $d = 0.25$

**Figure 72.** Causal relationships between sentiment indices and BTC price - $d = 0.35$



**Figure 74.** NLP2 (dynamic, with asset decay) sentiment index and Hash Rate

**Figure 75.** NLP2 (dynamic, with asset decay) sentiment index and Hash Rate

8. Empirical comparison of entropy sentiment index vs BERT and VADER indices

In Figures 76 - 85 we plot the sentiment indices built with the BERT and VADER models using the same set of data. Note the variability of our text time-series entropy indices compared to the other models. We conjecture that this is due to the ability of our index to adapt to the specificity of the domain, and therefore better capture the sentiment signal from public news. On the contrary, we may assume that the alternative models we employ produce a point estimate per day that is a lot less responsive to the high variability of investor's sentiment. This is because VADER has been constructed using Twitter posts, where the language is completely different to that of financial articles on cryptoassets, and more tuned to extreme sentiment expressions. In addition, neural network-type models like BERT are usually trained on general-domain corpora, in an attempt to aid generalisation to various out-of-sample domains. However, an increasing number of research outputs suggest that this is often not the case (e.g. see Park et al. (2019)), which is what we also see in the indices we constructed in the crypto space.

We observe that a robust summary of the n -gram daily sentiment of BERT and VADER does not express the intra-day variability - hence most days are in the same area (negative for BERT, neutral for VADER) for both models - compared to the construction of our entropy index whose robust daily summary captures the fast changing nature of the sentiment signal. It is also important to remind that while VADER and BERT evaluate sentiment based on sentences, we have used n -grams ($n = 20$ tokens) as text unit to evaluate the sentiment on. However, due to the size of the n -gram we used, one could not attribute the variability we capture to this difference in granularity of the unit of text processing, on the contrary - 20 words usually extend beyond the length of one sentence, which would tend to smooth the index compared to BERT's or VADER's indices.

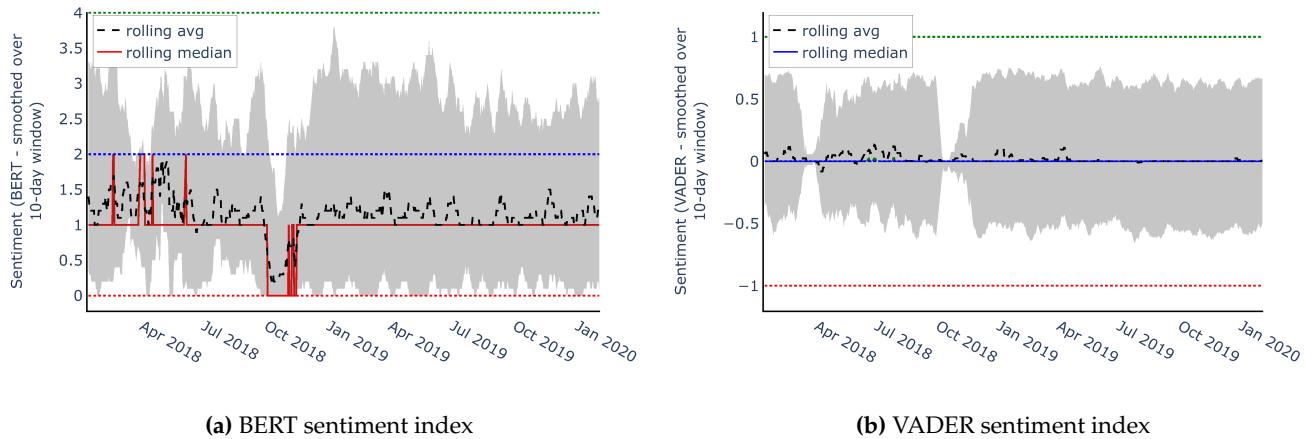


Figure 76. Sentiment indices constructed from Cryptodaily BTC articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

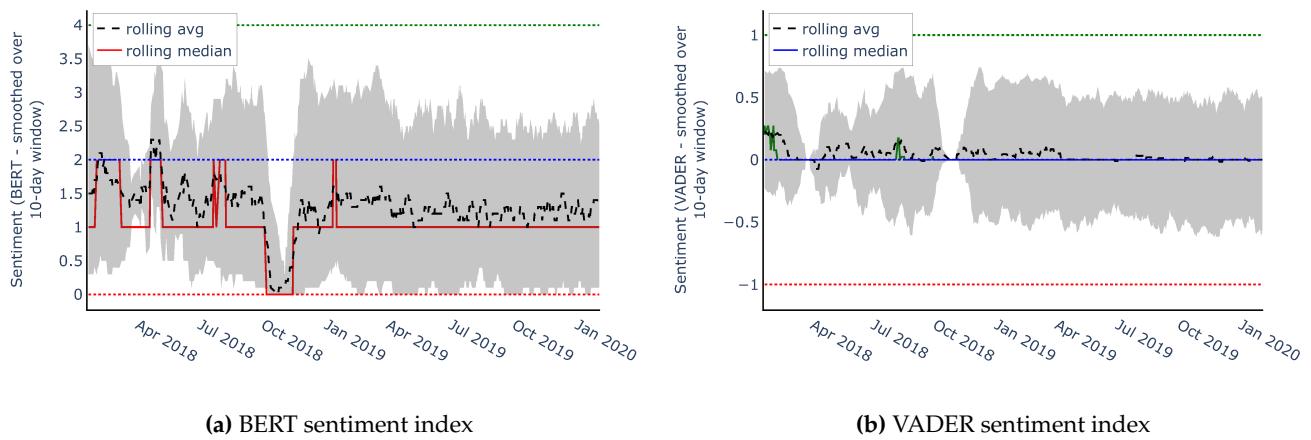


Figure 77. Sentiment indices constructed from Cryptodaily ETH articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

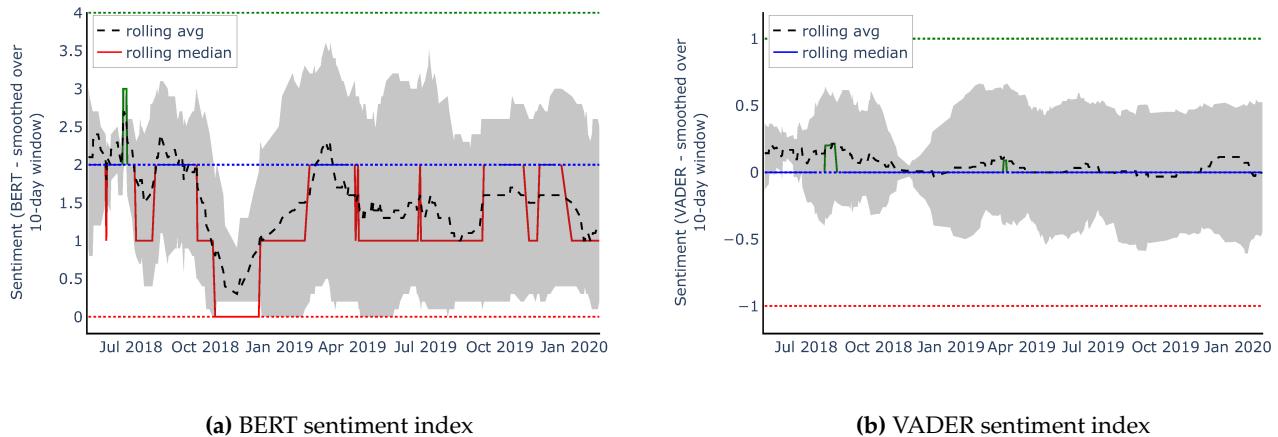


Figure 78. Sentiment indices constructed from Cryptodaily LTC articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

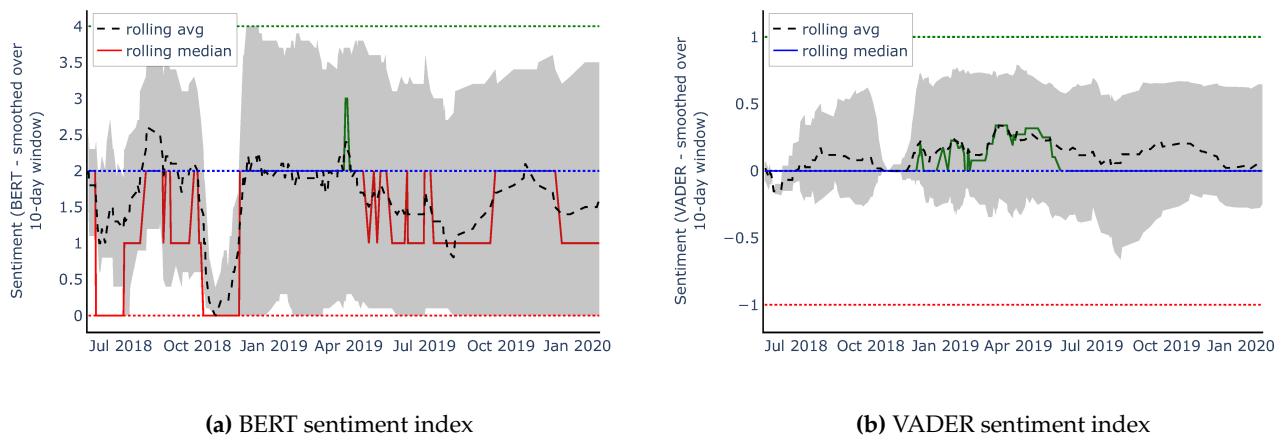
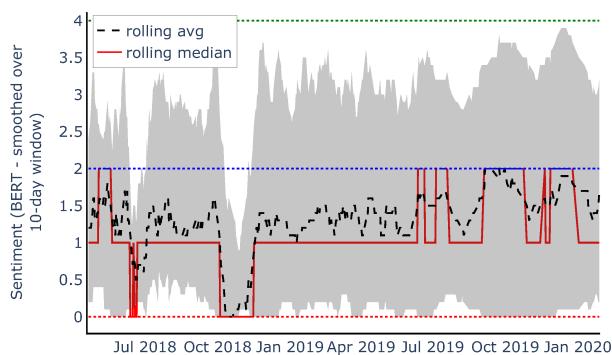
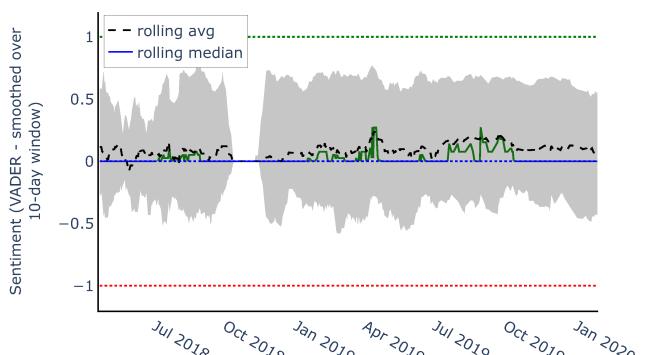


Figure 79. Sentiment indices constructed from Cryptodaily TRX articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

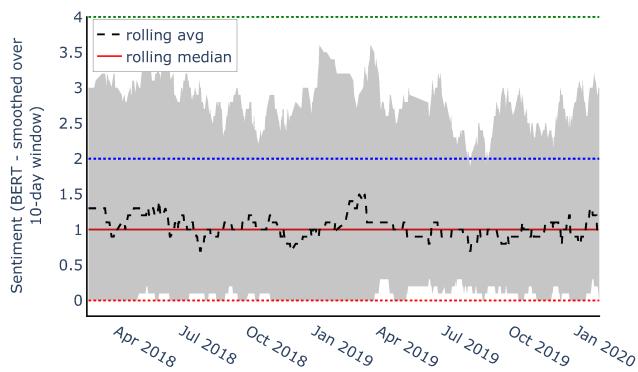


(a) BERT sentiment index

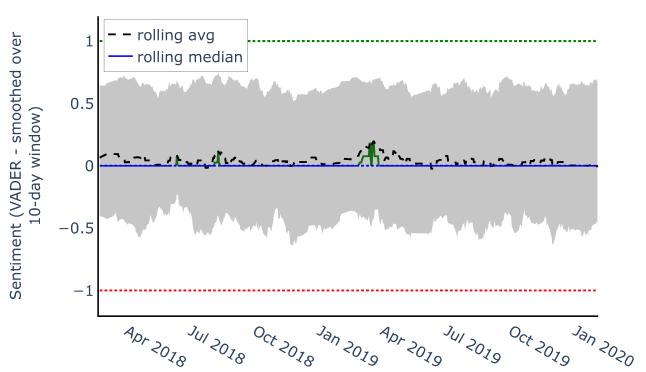


(b) VADER sentiment index

Figure 80. Sentiment indices constructed from Cryptodaily XRP articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

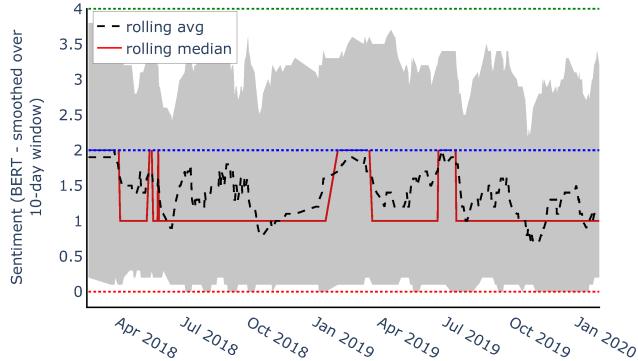


(a) BERT sentiment index

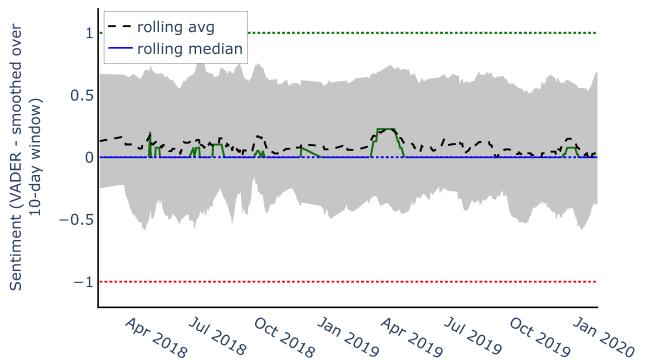


(b) VADER sentiment index

Figure 81. Sentiment indices constructed from Cryptoslate BTC articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

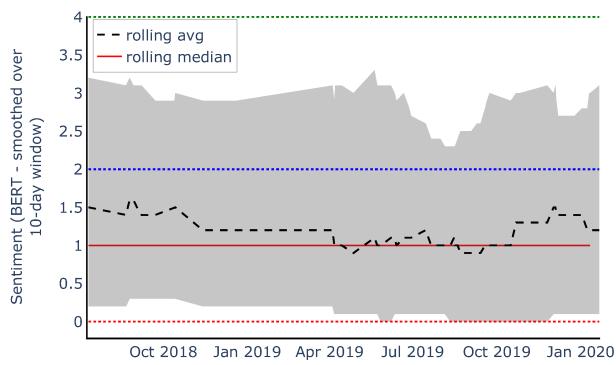


(a) BERT sentiment index

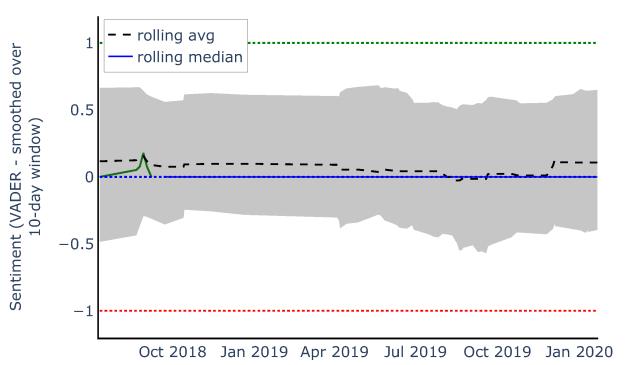


(b) VADER sentiment index

Figure 82. Sentiment indices constructed from Cryptoslate ETH articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.



(a) BERT sentiment index



(b) VADER sentiment index

Figure 83. Sentiment indices constructed from Cryptoslate LTC articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

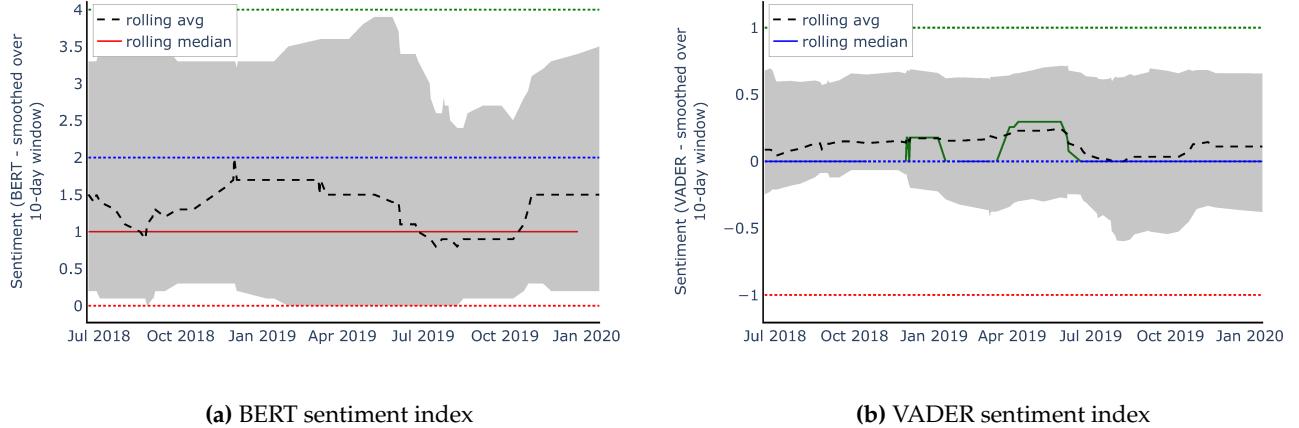


Figure 84. Sentiment indices constructed from Cryptoslate TRX articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

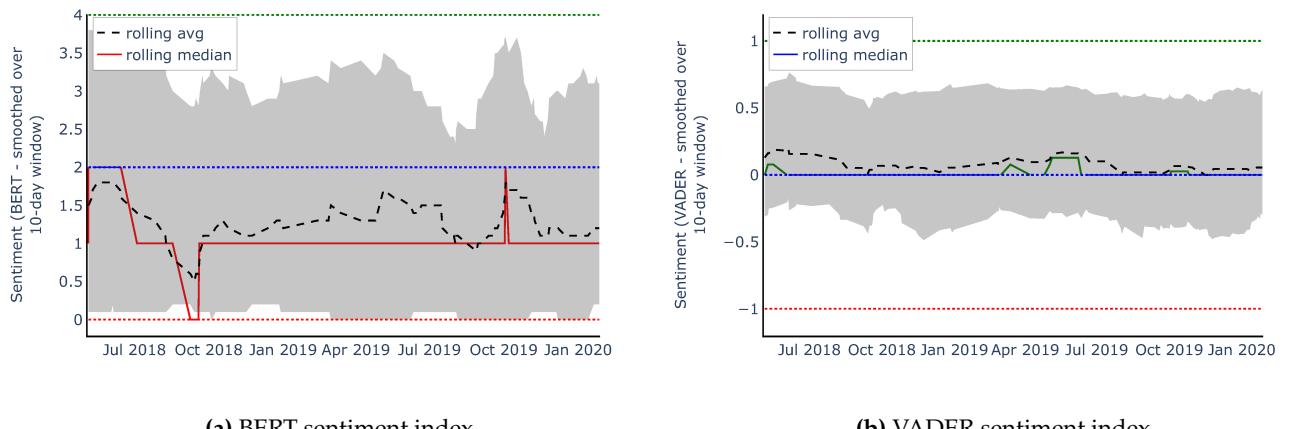


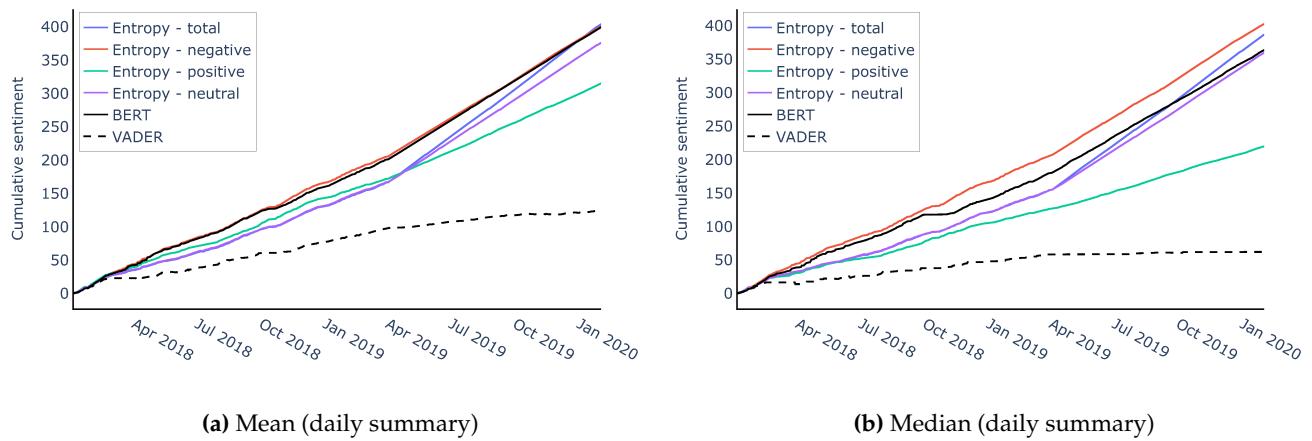
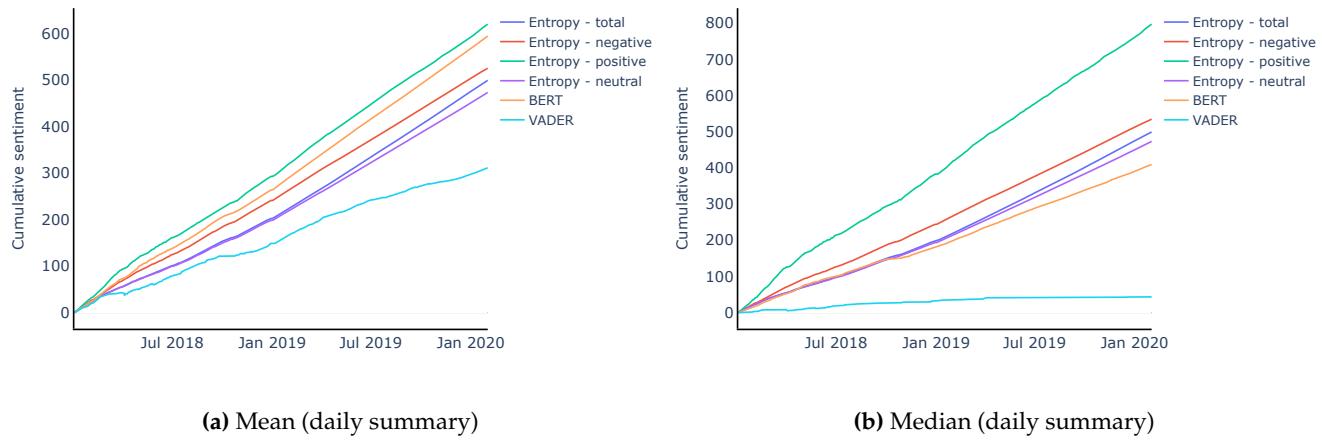
Figure 85. Sentiment indices constructed from Cryptoslate XRP articles using BERT and VADER. Dotted lines are the boundary values, where green denotes positive sentiment, red negative and blue neutral.

8.1 Growth rate of sentiment over time

Figure 86 shows the cumulative plots of mean and median daily sentiment relative to the beginning of the time period of interest for BTC articles from Cryptodaily. The rates of change of the lines reveal whether the aggregation of sentiment is continuous or intermittent over time, and whether it is affected by sentiment polarity or not. We observe the linear growth of cumulative sentiment, and almost constant rate of change which means that there is a smooth variation in the way information is captured: a growing amount of different information is accumulated over time, as opposed to certain abrupt rare events driving the index. The fact that the growth is linear in this instance (Cryptodaily/BTC) is in part due to the fact that the information source is rich, i.e. there are

articles on Cryptodaily regarding BTC almost on a daily basis during the time period we are studying. The linear pattern however may change, as we may see in the growth rate plots for the rest of the assets and news sources (Figures 87 - 95). From Figure 86 (left) we understand that BERT and VADER accumulate sentiment at different rates. VADER is slower at gathering information, and in addition, gathers sentiment information that is different to any of the information captured by our entropy indices. This is because its rate of change is significantly lower than the rate of the entropy indices. On the contrary, we see that BERT's growth rate is almost the same as that of our positive entropy index (almost parallel lines). Given that BERT has identified mostly negative sentiment (99% of the time) as we saw in Figure 76 (left, BERT) we interpret this observation as a difference in the understanding of sentiment polarity between our positive entropy index and BERT, given that both are based on the same texts: what the entropy index perceives as positive sentiment, BERT sees as mostly negative. In addition, we see that until April 2019, the neutral index is almost identical to the absolute sentiment strength and deviate a little after that point; this means that most of the time the neutral index captures the same global sentiment tendency as the absolute strength index. In Figure 86 (right) we observe that the line corresponding to VADER is almost flat. Comparing with the non-flat line of VADER in 86 (left) this means that the accumulation of sentiment by VADER fluctuates around zero, and therefore in general VADER has been unable to extract sentiment information from the given articles. This is in agreement with the flat line we observe in the smoothed index of Figure 76 (right, VADER), and we can attribute it to the fact that VADER is trained on general online media content and therefore lacks the specificity required for the crypto domain. We also observe that BERT matches the neutral and absolute strength indices until about November 2018, which means that a robust daily summary of BERT is able to account for global sentiment strength but not a specific sentiment polarity. Comparing with BERT's index using the mean daily summary, which has a slightly higher rate, we understand that BERT gathers information mostly about the sentiment magnitude, rather than polarity. Note also the small flat region in BERT's index during October 2018. At that time the BTC price exhibited little variation, yet it was a period during which the sentiment signal was strong due to the unrest caused to the investors by the price dynamics. BERT however was incapable of capturing that (negative) sentiment signal. Finally, in both plots we can see that the rate of change is not constant all of the time - it is higher at the start of the period. This is more distinctly shown in the positive entropy index in the right plot of Figure 86. This period corresponds to the period of the BTC price peak of January 2018 and we can see that our positive sentiment index reacts more strongly to the resulting sentiment signal.

Figures 87 - 95 include the growth rate plots for the rest of the assets and sources. Note the varying patterns and the non-linear rate that most assets exhibit.



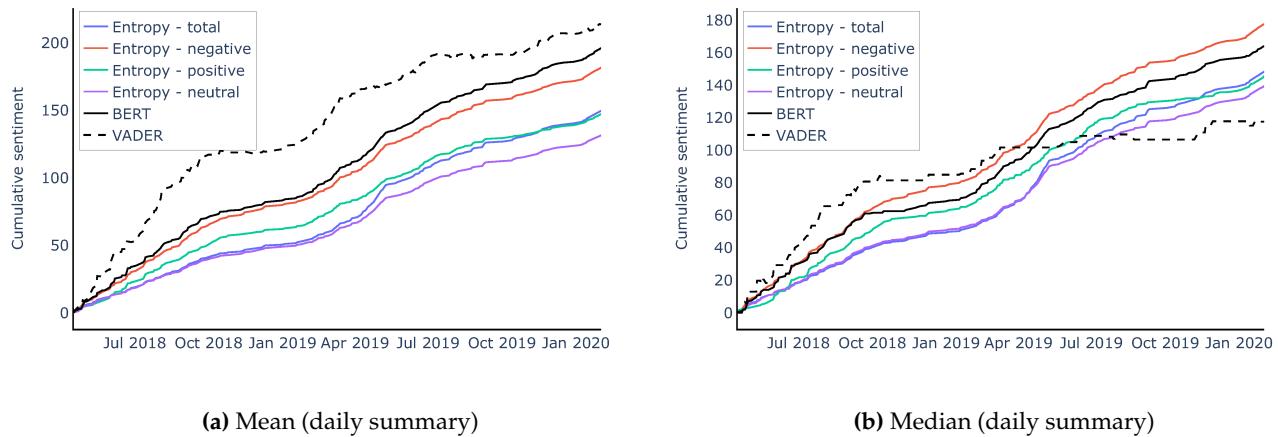


Figure 88. LTC cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptodaily

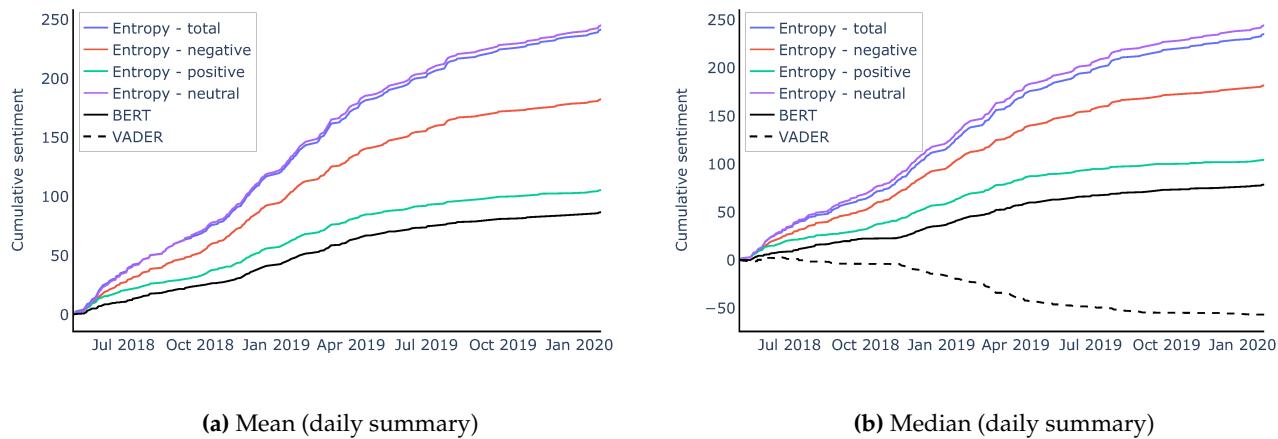


Figure 89. TRX cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptodaily

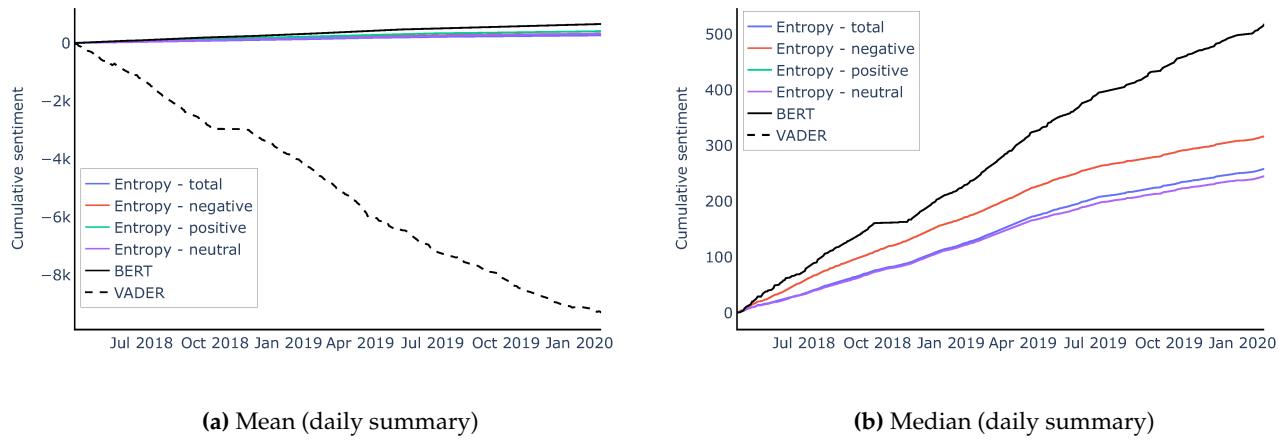


Figure 90. XRP cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptodaily

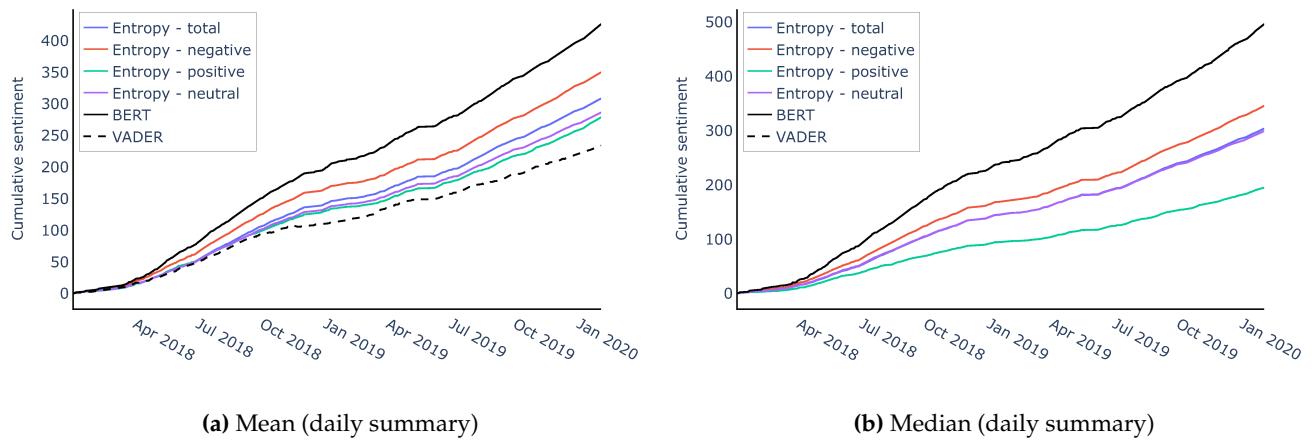
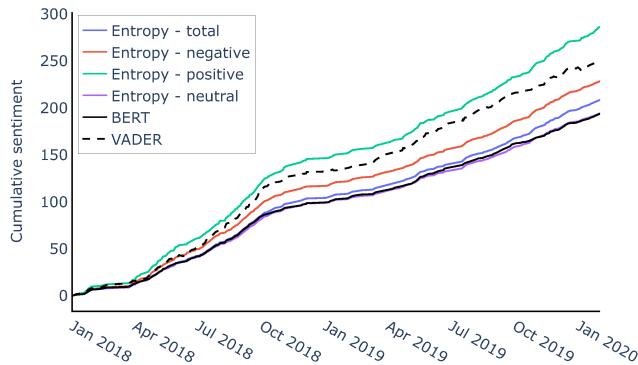
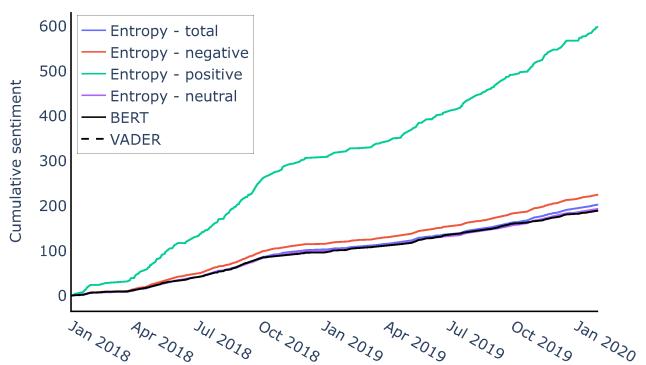


Figure 91. BTC cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptoslate

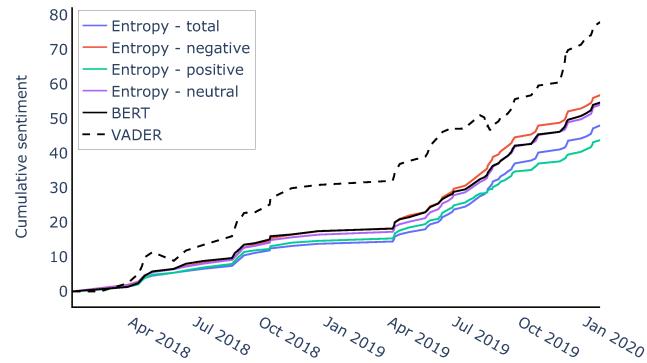


(a) Mean (daily summary)

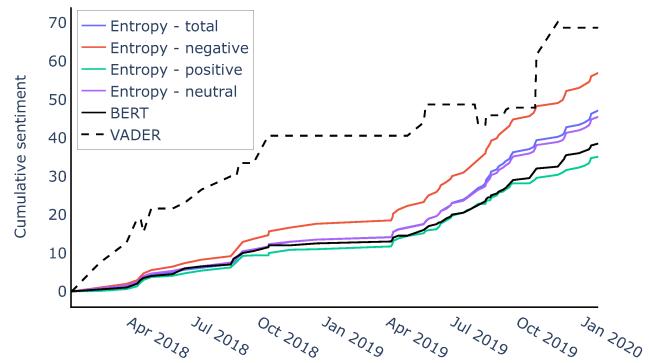


(b) Median (daily summary)

Figure 92. ETH cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptoslate

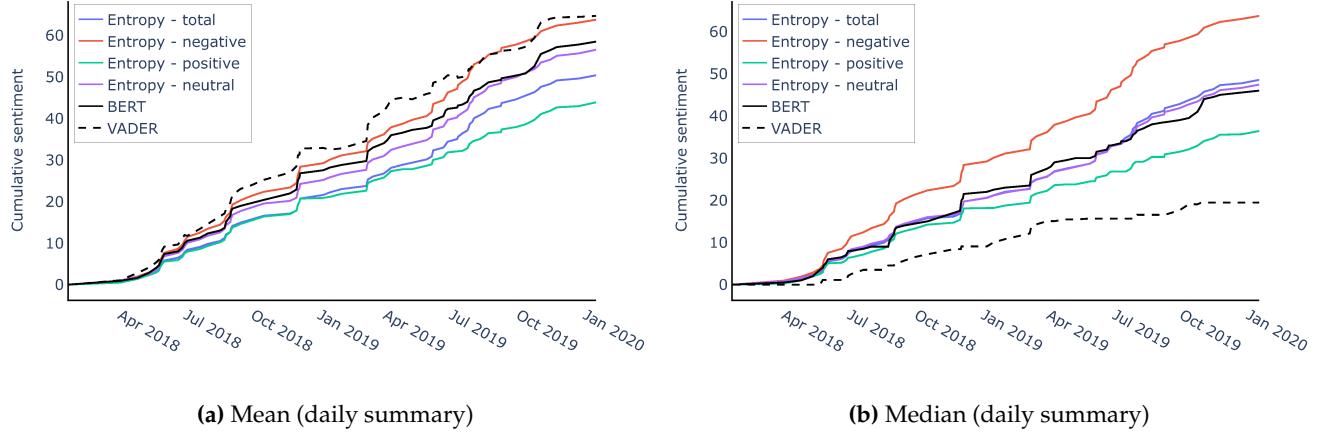
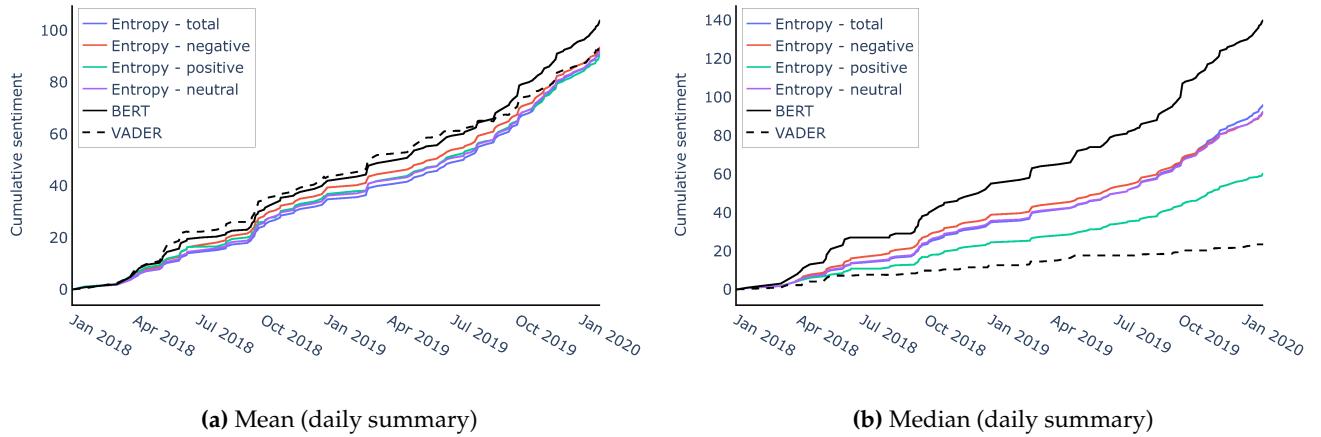


(a) Mean (daily summary)



(b) Median (daily summary)

Figure 93. LTC cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptoslate

**Figure 94.** TRX cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptoslate**Figure 95.** XRP cumulative sentiment (relativised w.r.t. starting sentiment) - Cryptoslate

8.2. Pair grid correlation and tail dependence plots

We next study the cross-correlation of each entropy-based sentiment index with the indices obtained from BERT and VADER. We measure linear correlation between the entropy sentiment and VADER, and rank correlation between entropy and BERT, due to the categorical nature of the BERT index. We present a summary of our analysis in Figure 96 for sentiment indices from Bitcoin Cryptodaily articles and note the lack of significant correlation between the indices. This encourages us to believe that it is meaningful to construct the different sentiment indices based on sentiment type (in addition to news source and asset), as each can provide information that is distinct from the index capturing the general sentiment strength. In addition, we have measured the upper and lower tail dependence between the indices via the extremogram of [Davis and Mikosch \(2009\)](#). We observe that BERT and VADER show strong lower tail dependence with all entropy indices and some dependence in the upper

tail with the negative entropy index. This verifies our intuition that due to their training and lack of specificity that it induces, the resulting indices can only react to rare shocks in the news sentiment and miss more regular variation. We also note the strong correlation and lower tail dependence between the absolute sentiment strength and the neutral entropy index, which confirms our observations from Figure 86 regarding their co-movement. On the contrary, the positive and negative entropy indices exhibit stronger upper tail dependence with the absolute strength index, which means that they capture more specific, extreme expressions of the sentiment signal towards each (positive/negative) side as was our intention when constructing them.

For the cross-correlation over time between sentiments from different cryptoassets and news sources, we present Figures 97-105.

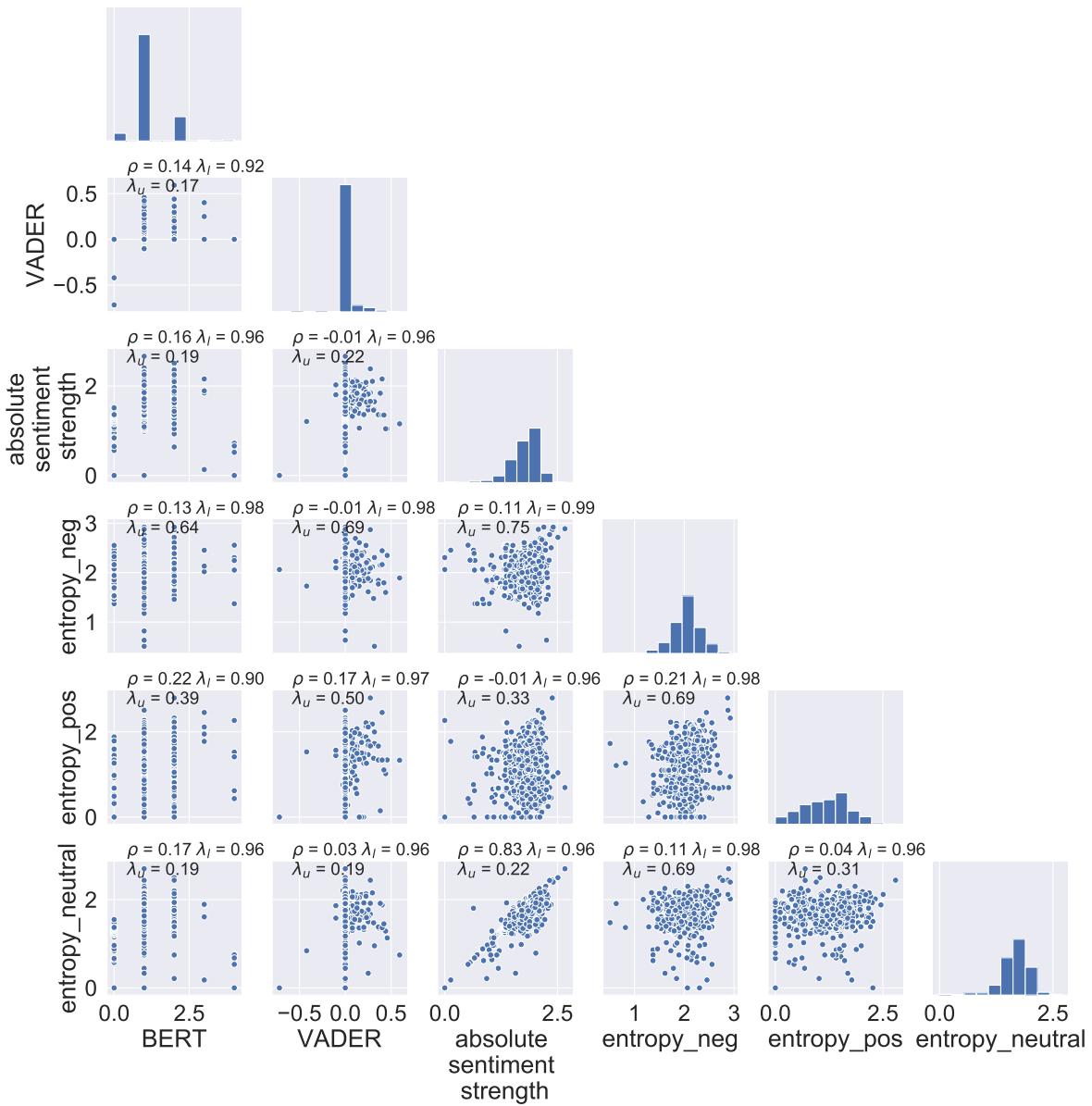


Figure 96. Cross-correlation between sentiment indices - Cryptodaily/BTC

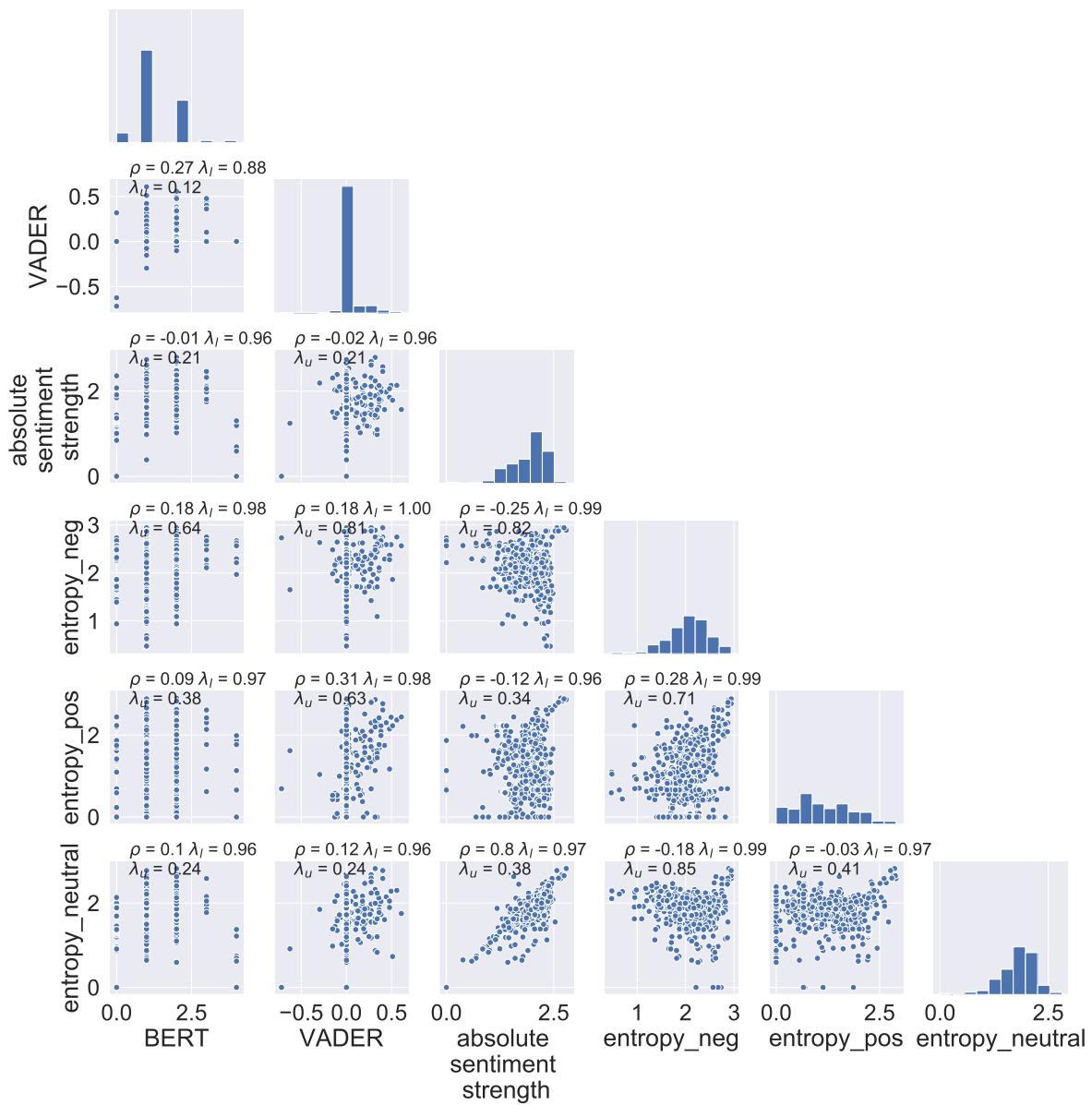
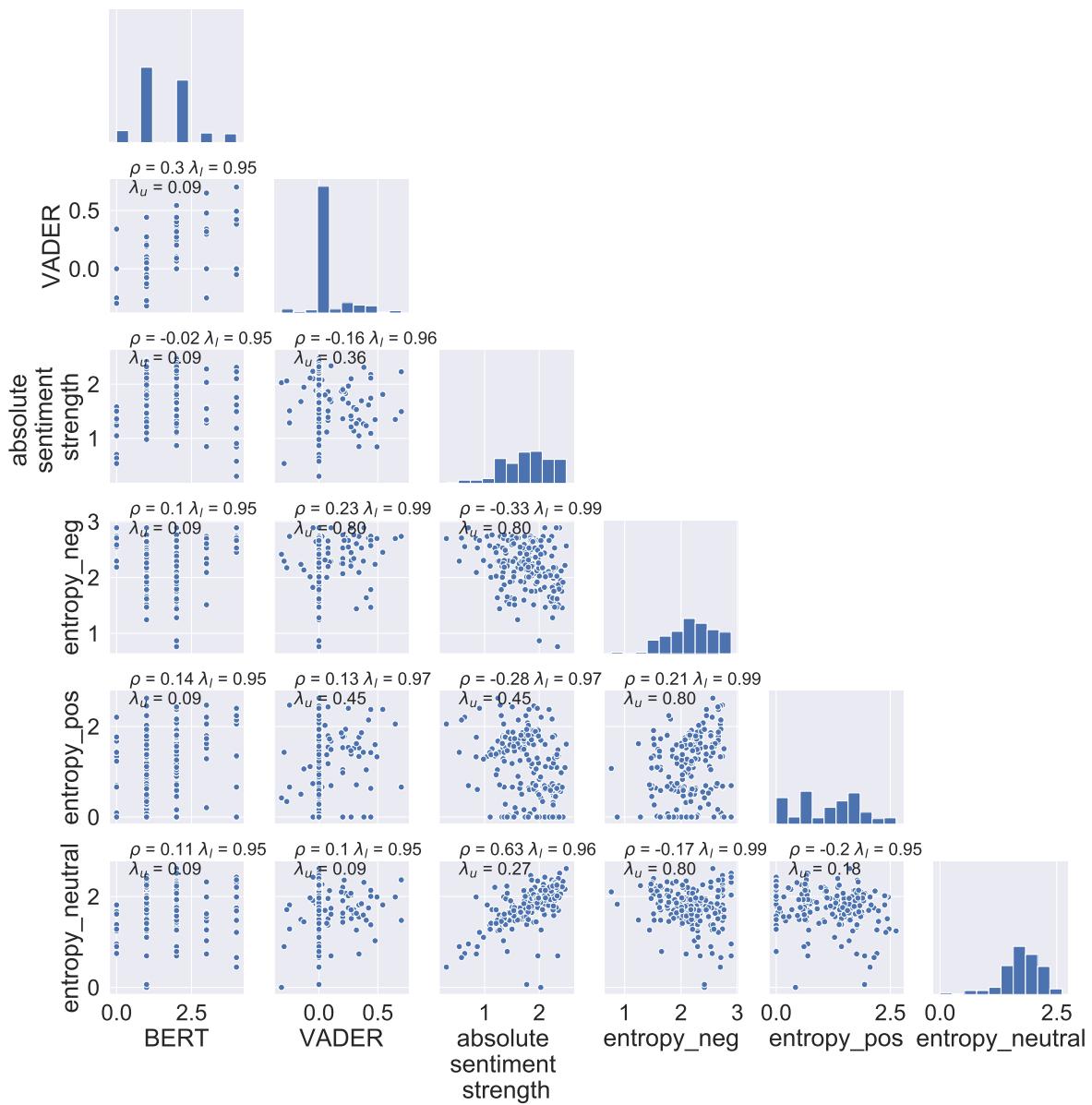
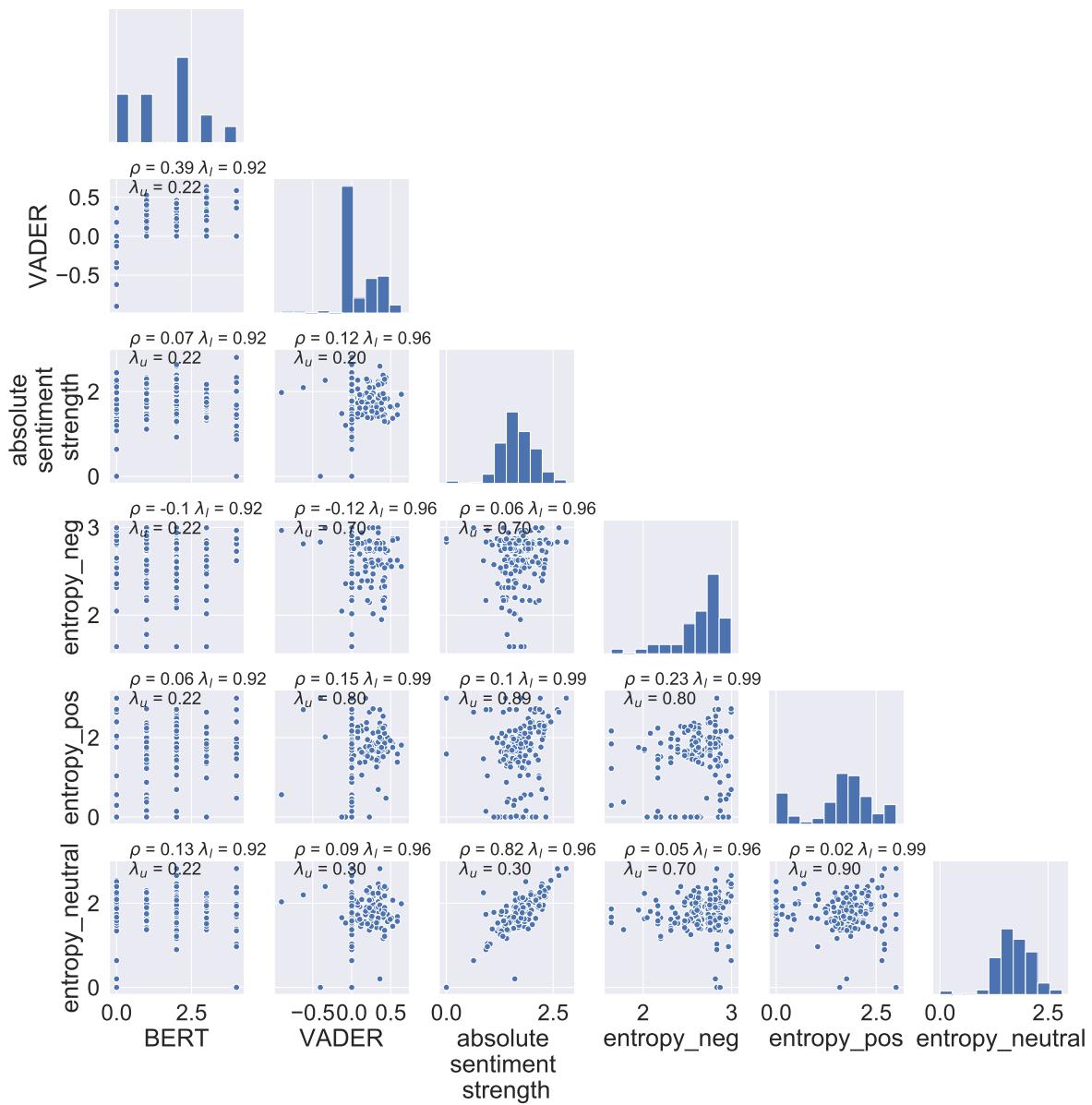
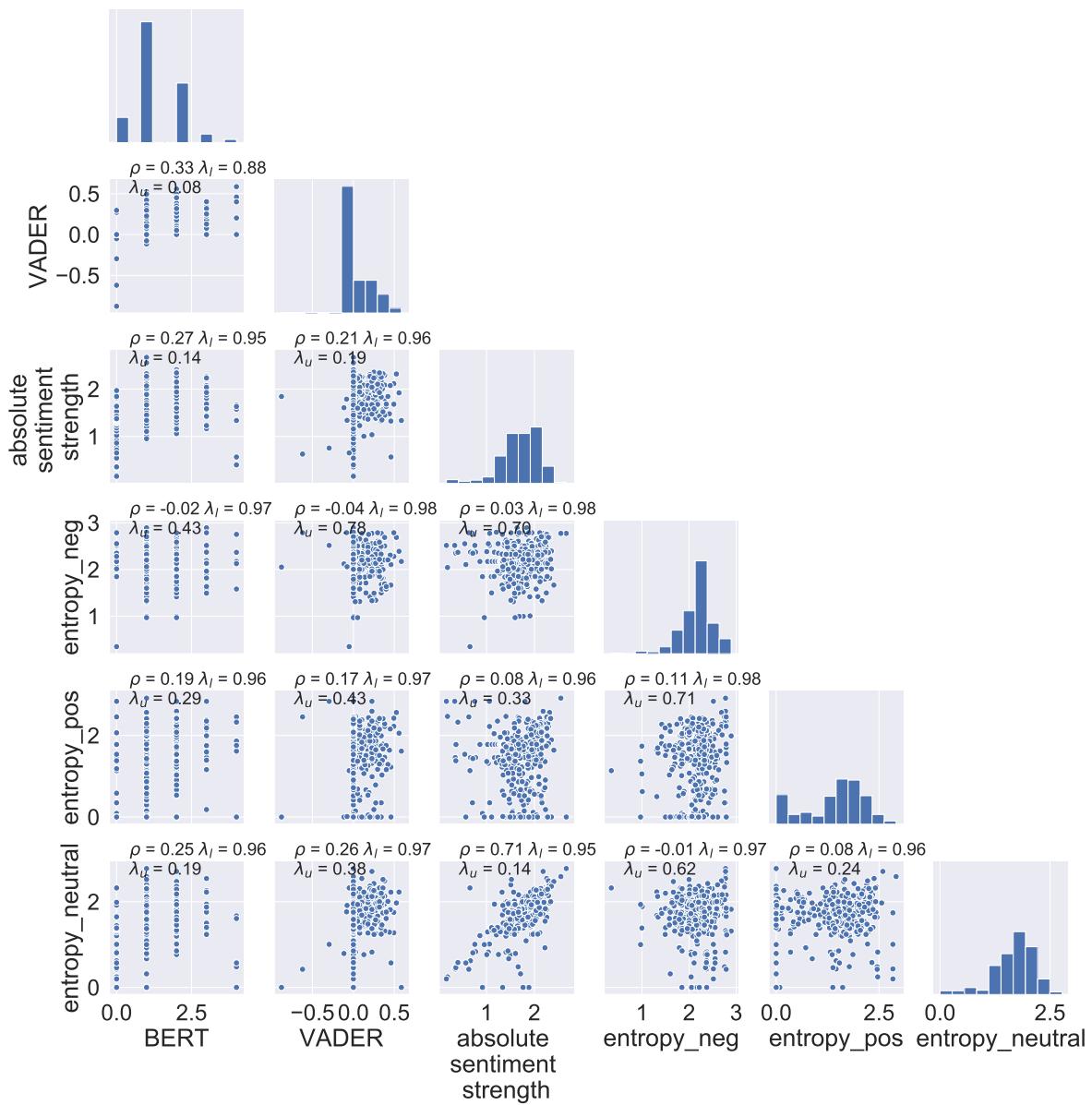
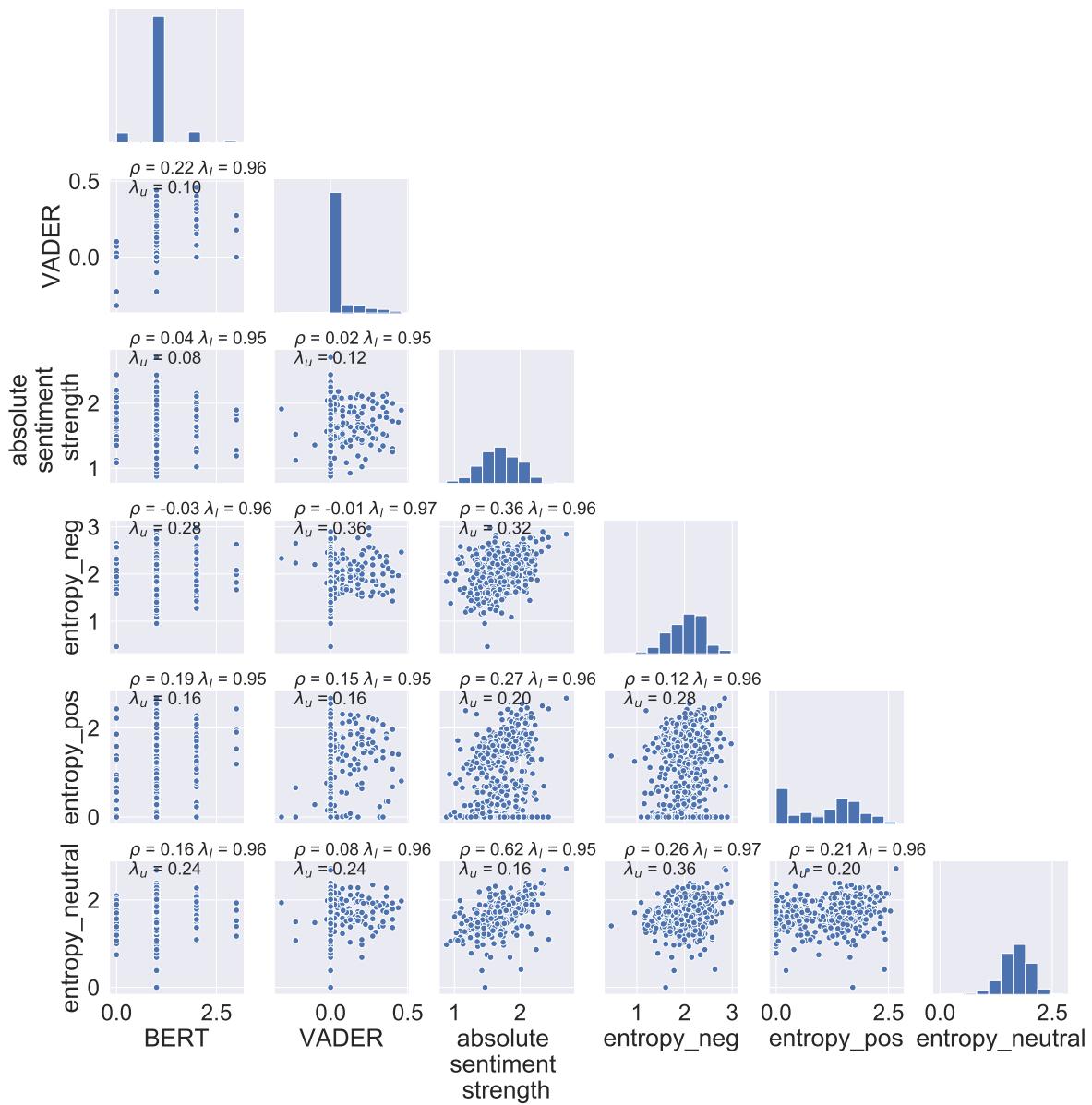


Figure 97. Cross-correlation between sentiment indices - Cryptodaily/ETH

**Figure 98.** Cross-correlation between sentiment indices - Cryptodaily/LTC

**Figure 99.** Cross-correlation between sentiment indices - Cryptodaily/TRX

**Figure 100.** Cross-correlation between sentiment indices - Cryptodaily/XRP

**Figure 101.** Cross-correlation between sentiment indices - Cryptoslate/BTC

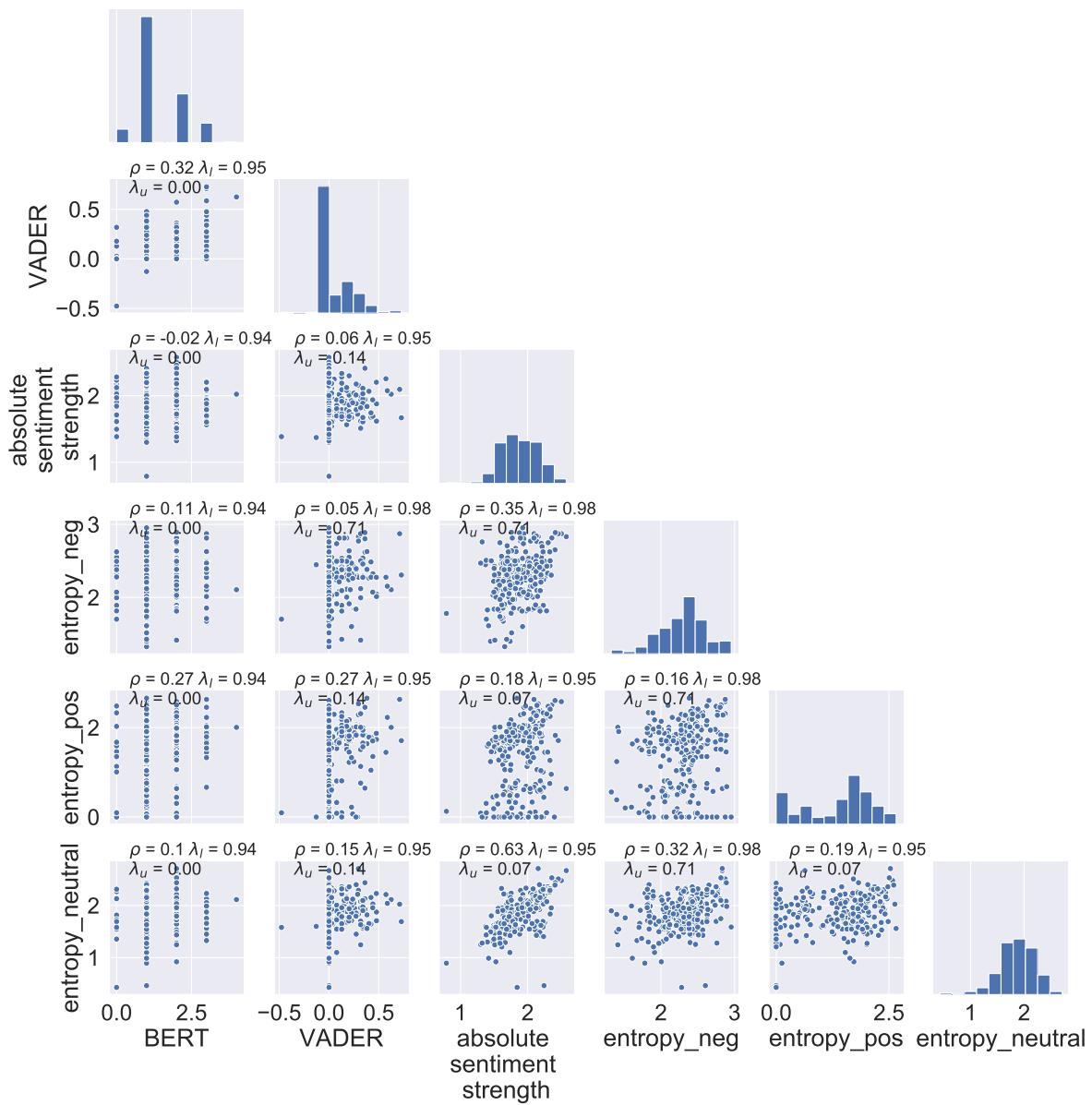


Figure 102. Cross-correlation between sentiment indices - Cryptoslate/ETH

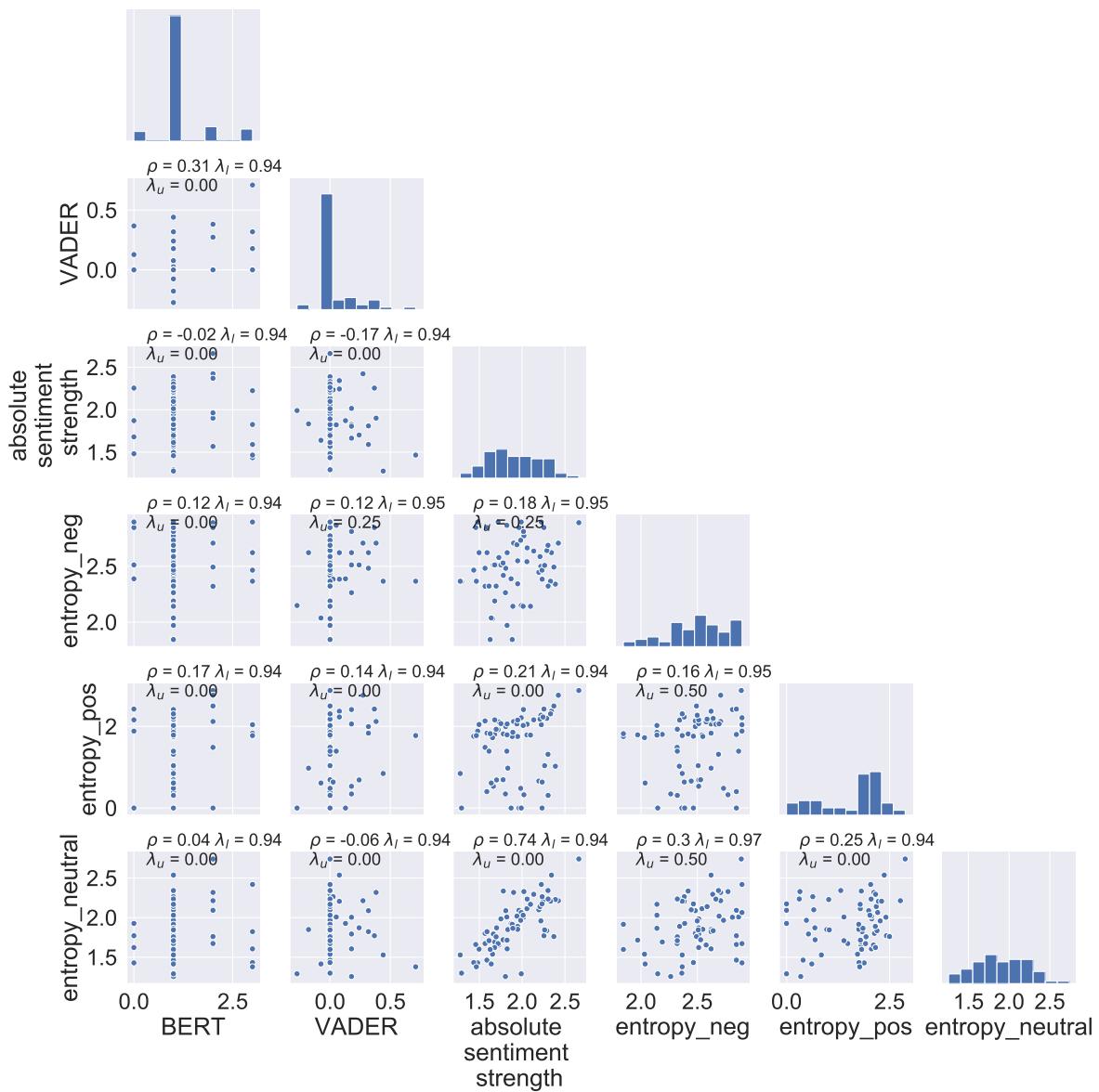
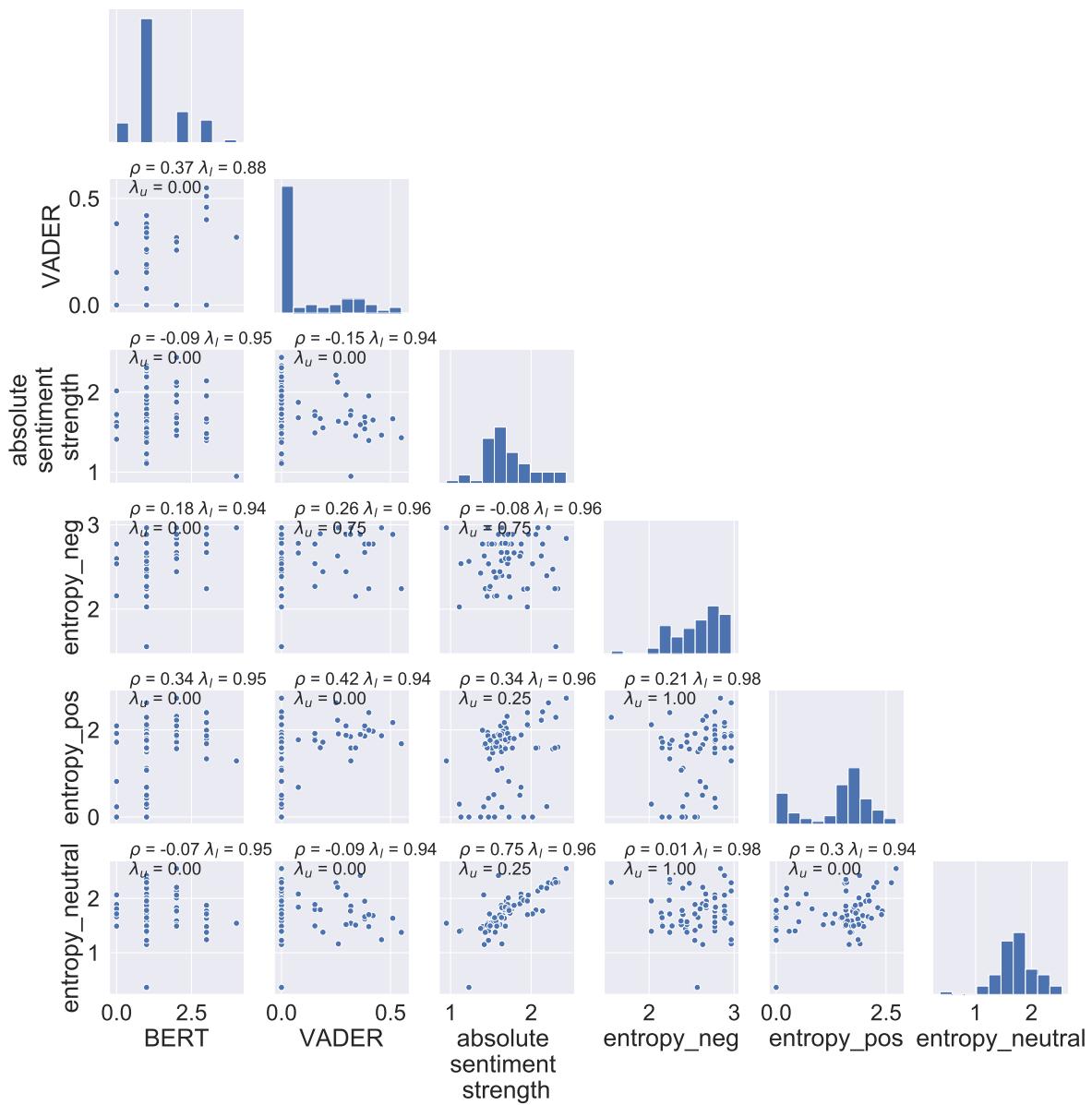


Figure 103. Cross-correlation between sentiment indices - Cryptoslate/LTC

**Figure 104.** Cross-correlation between sentiment indices - Cryptoslate/TRX

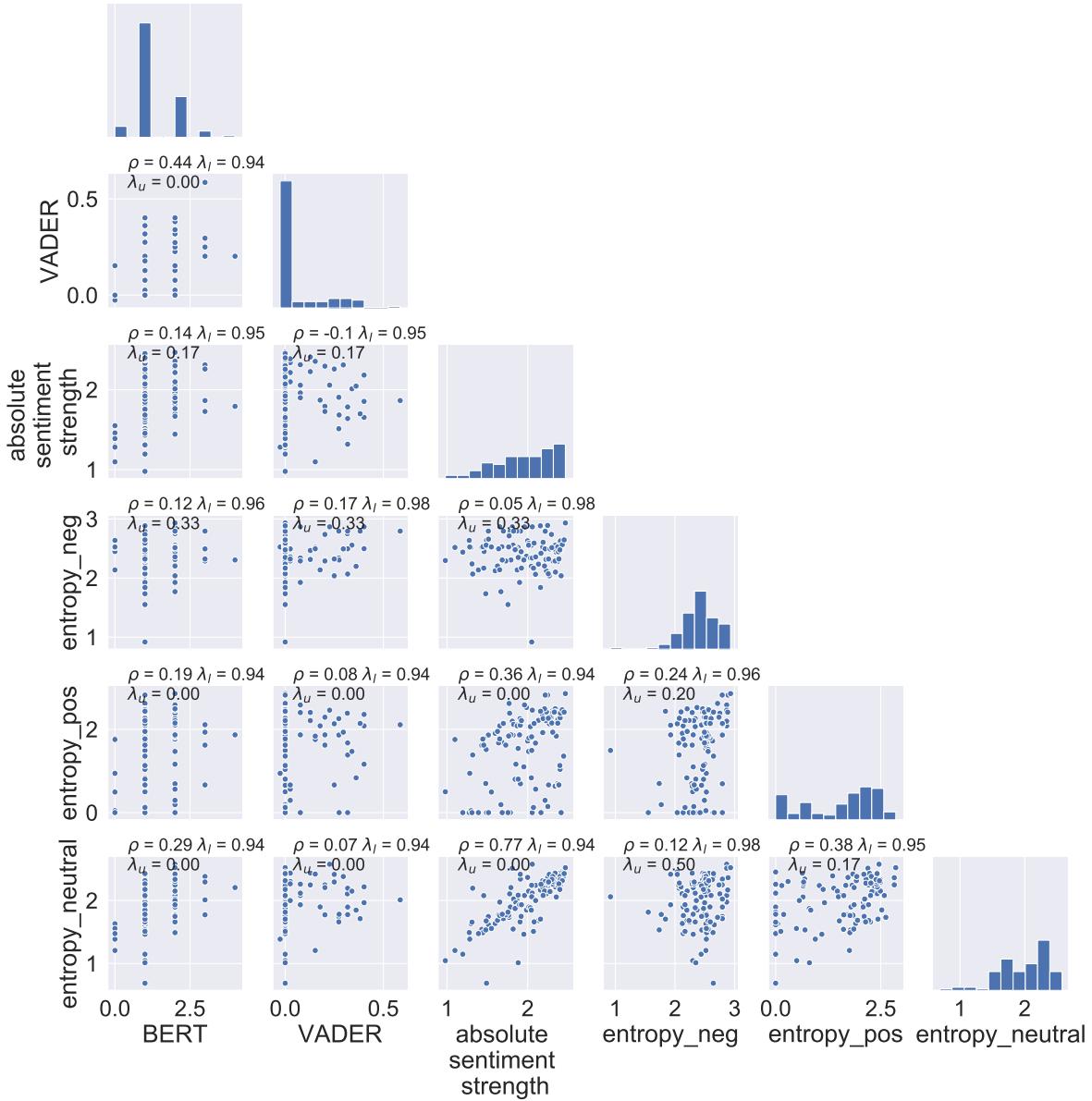


Figure 105. Cross-correlation between sentiment indices - Cryptoslate/XRP

8.3. Sentiment distributions

To further investigate the sentiment indices in terms of their behaviour in our current domain, we plot and compare the densities of the sentiment distributions. We begin by constructing kernel density estimates of the distributions of the sentiment indices (daily median filter) from the text time-series based on entropy. For the density estimates of BERT and VADER we construct the empirical histograms with the corresponding box plots, and note that the latter are primarily just dots for the points where probability concentrates.

These plots may be used to obtain insights about the reporting of the different news sources on the crypto assets. For example, it appears that the Cryptodaily sentiment distributions have longer tails, i.e. contain more outliers, in comparison to the sentiment distributions of Cryptoslate which exhibit higher interquartile range. This

could mean that the language of Cryptoslate articles contains less crypto jargon compared to Cryptodaily, and is therefore perhaps more amicable to novice investors.

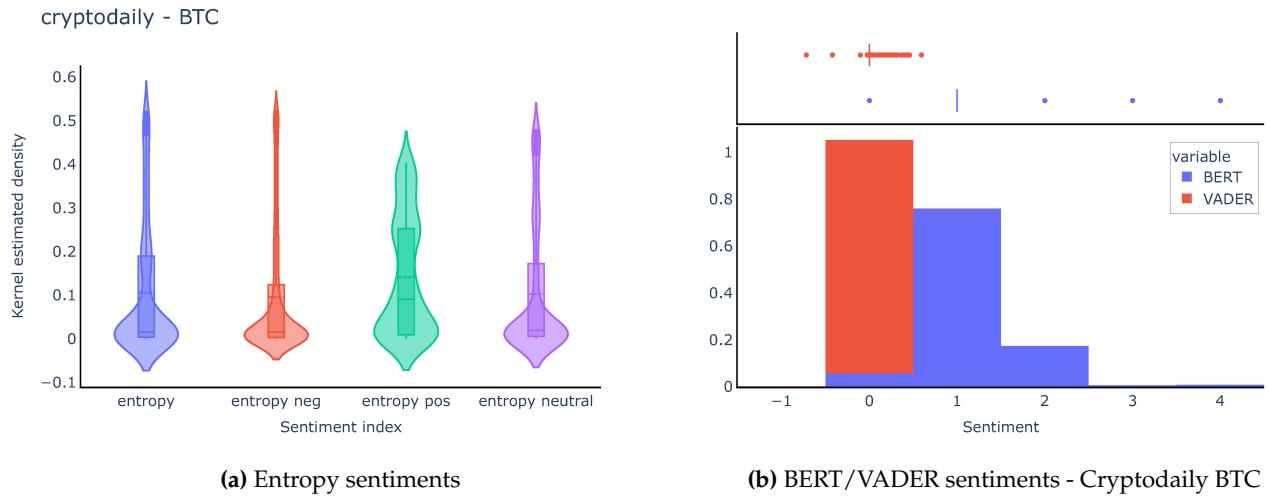


Figure 106. Density estimates of sentiment models - Cryptodaily BTC

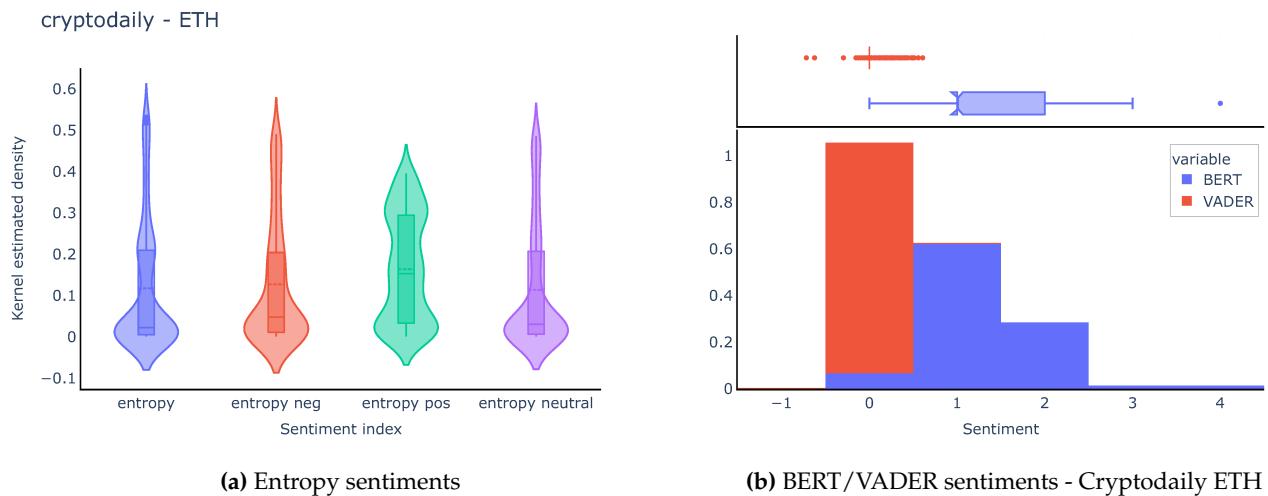


Figure 107. Density estimates of sentiment models - Cryptodaily ETH

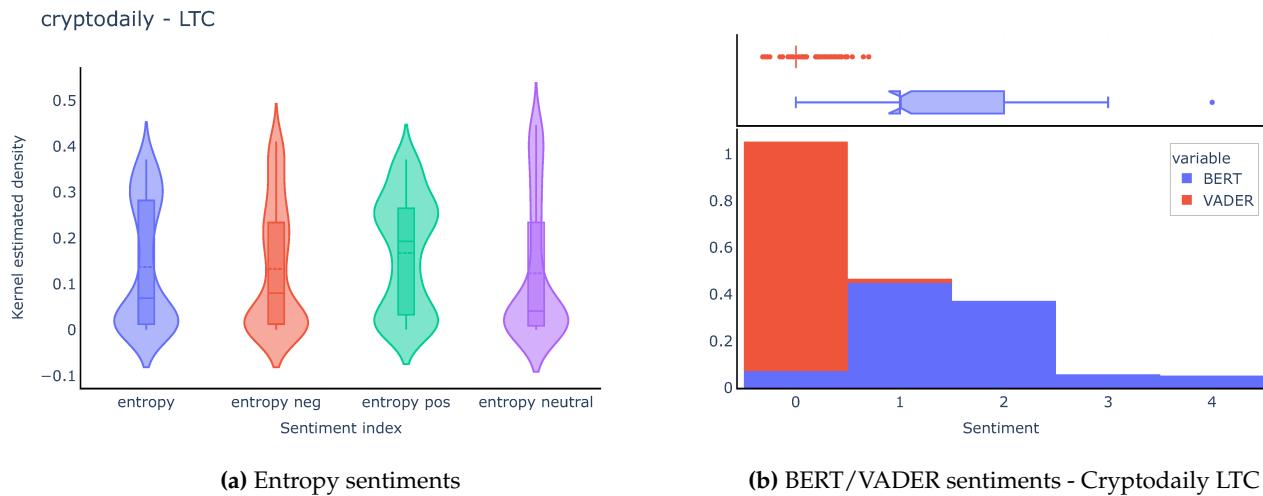


Figure 108. Density estimates of sentiment models - Cryptodaily LTC

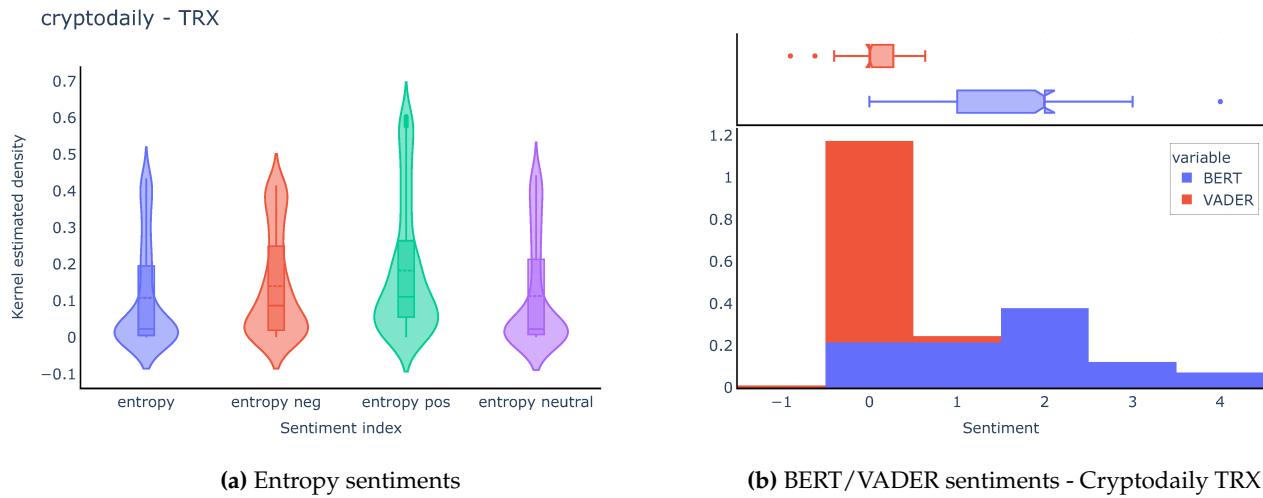


Figure 109. Density estimates of sentiment models - Cryptodaily TRX

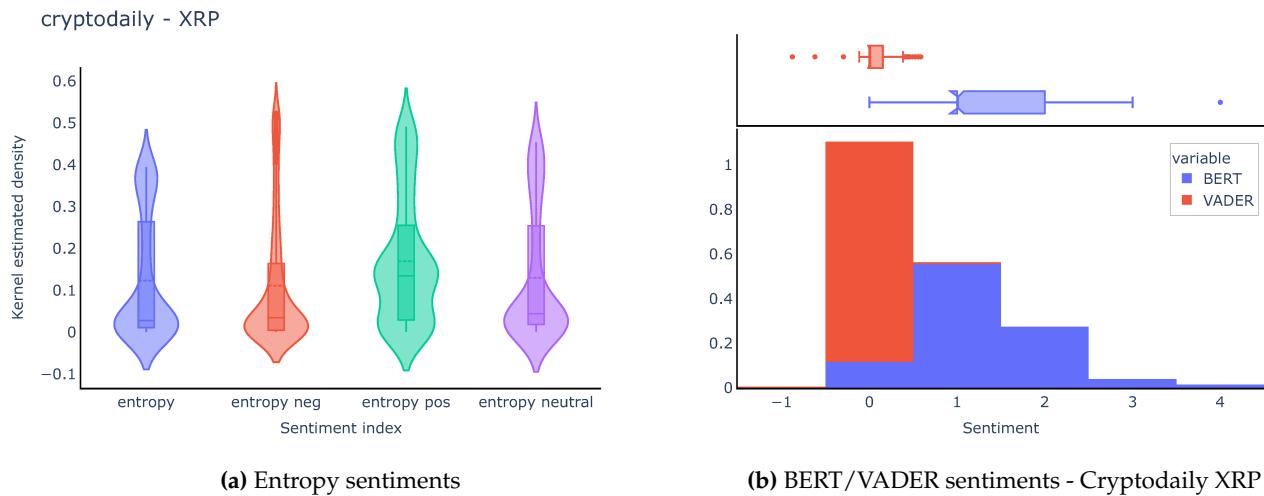


Figure 110. Density estimates of sentiment models - Cryptodaily XRP

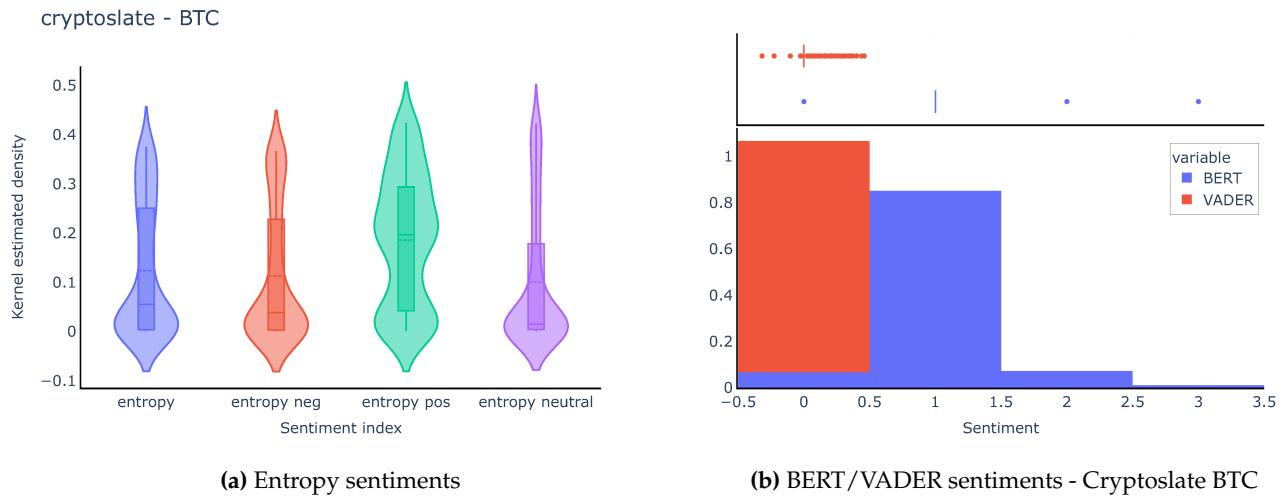
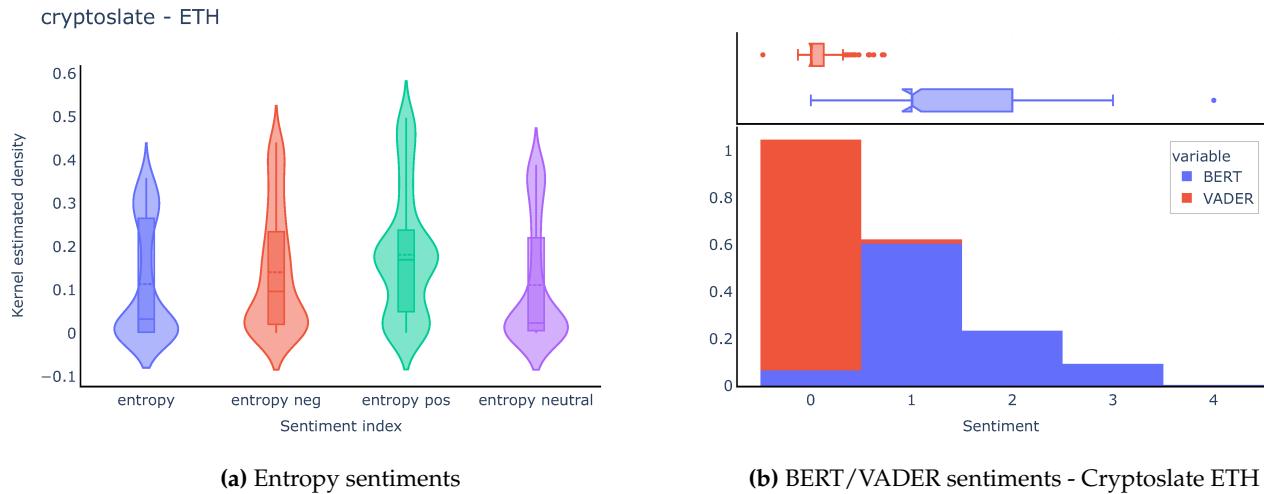
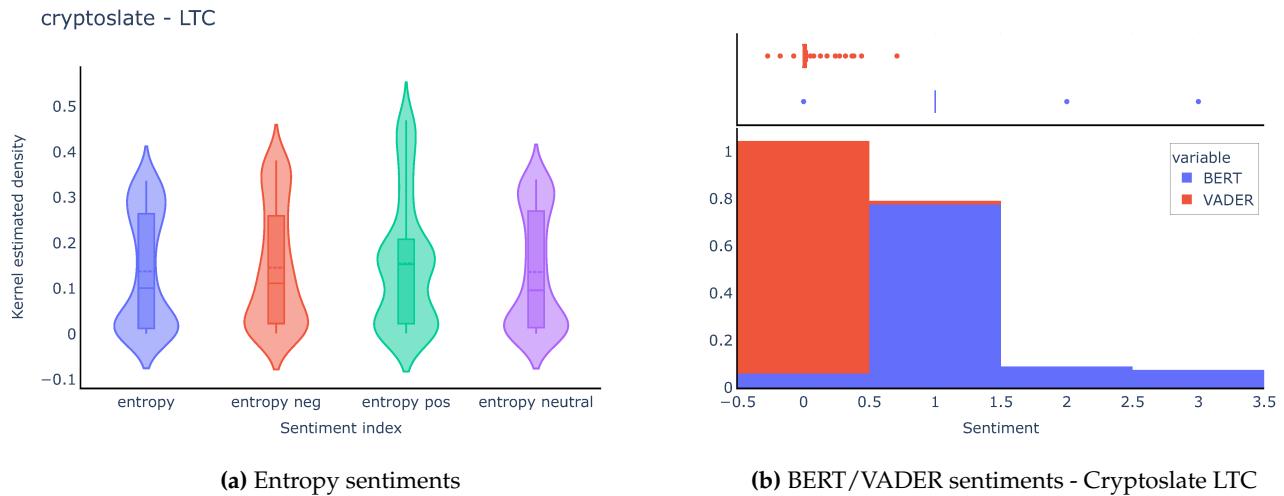


Figure 111. Density estimates of sentiment models - Cryptoslate BTC

**Figure 112.** Density estimates of sentiment models - Cryptoslate ETH**Figure 113.** Density estimates of sentiment models - Cryptoslate LTC

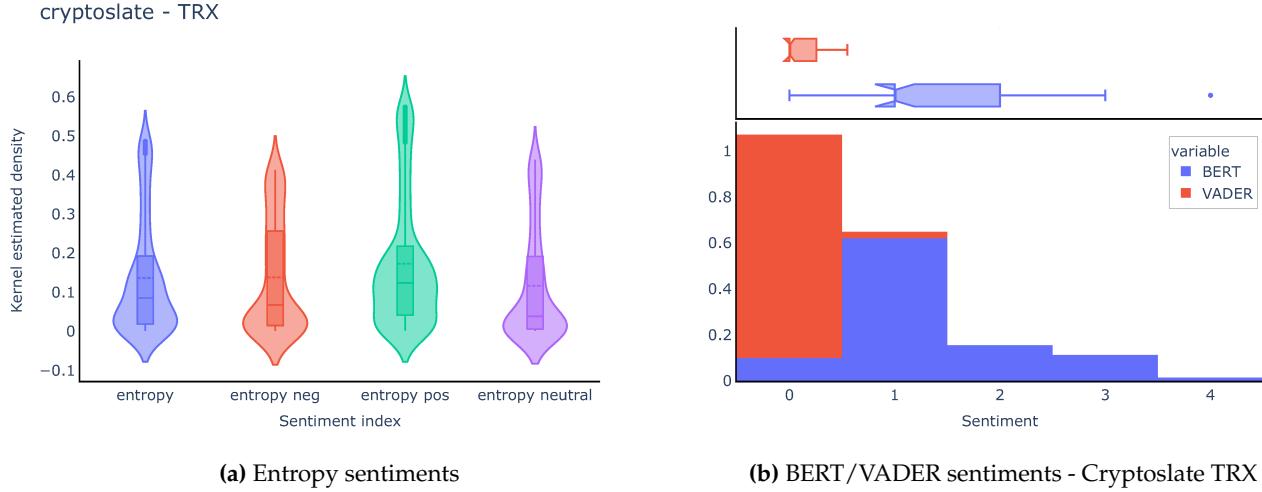


Figure 114. Density estimates of sentiment models - Cryptoslate TRX

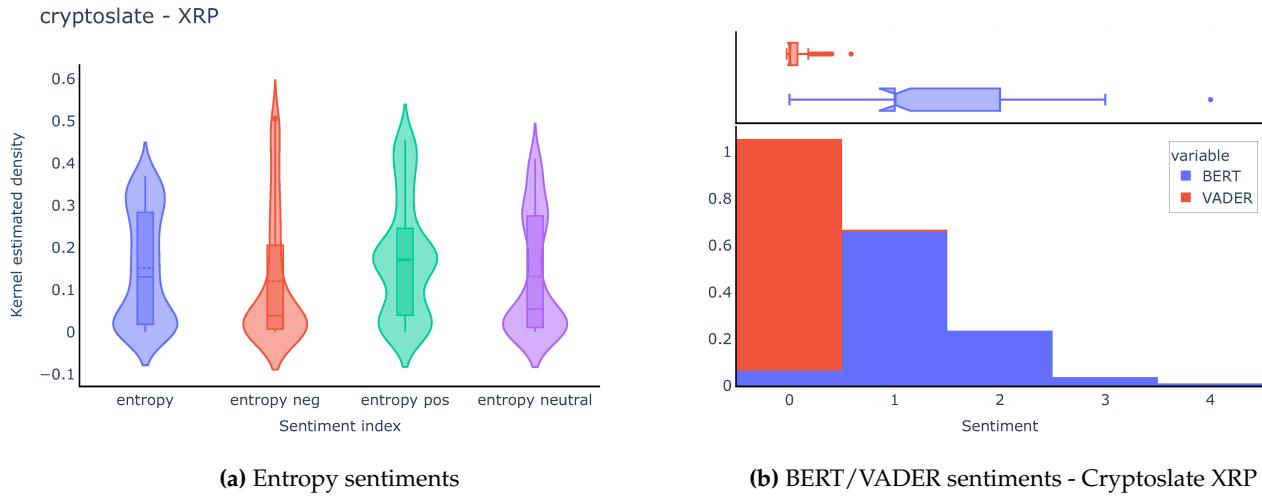


Figure 115. Density estimates of sentiment models - Cryptoslate XRP

8.4. Cross-correlation of entropy and comparative indices

We then empirically study the relationship between the entropy sentiment indices. We construct the rolling window cross-correlations (3-month window/3-week in case of less data, 1-week step) and plot them in Figure 116. We observe the lack of correlation even between reporting about the same cryptoasset (e.g. BTC) from different news sources. This means that the index capturing absolute sentiment strength contains different information to the sentiment-specific indices, and is therefore meaningful to study both. Finally, we show how this correlation evolves per time, for the different assets and news sources in Figures 117 - 153.

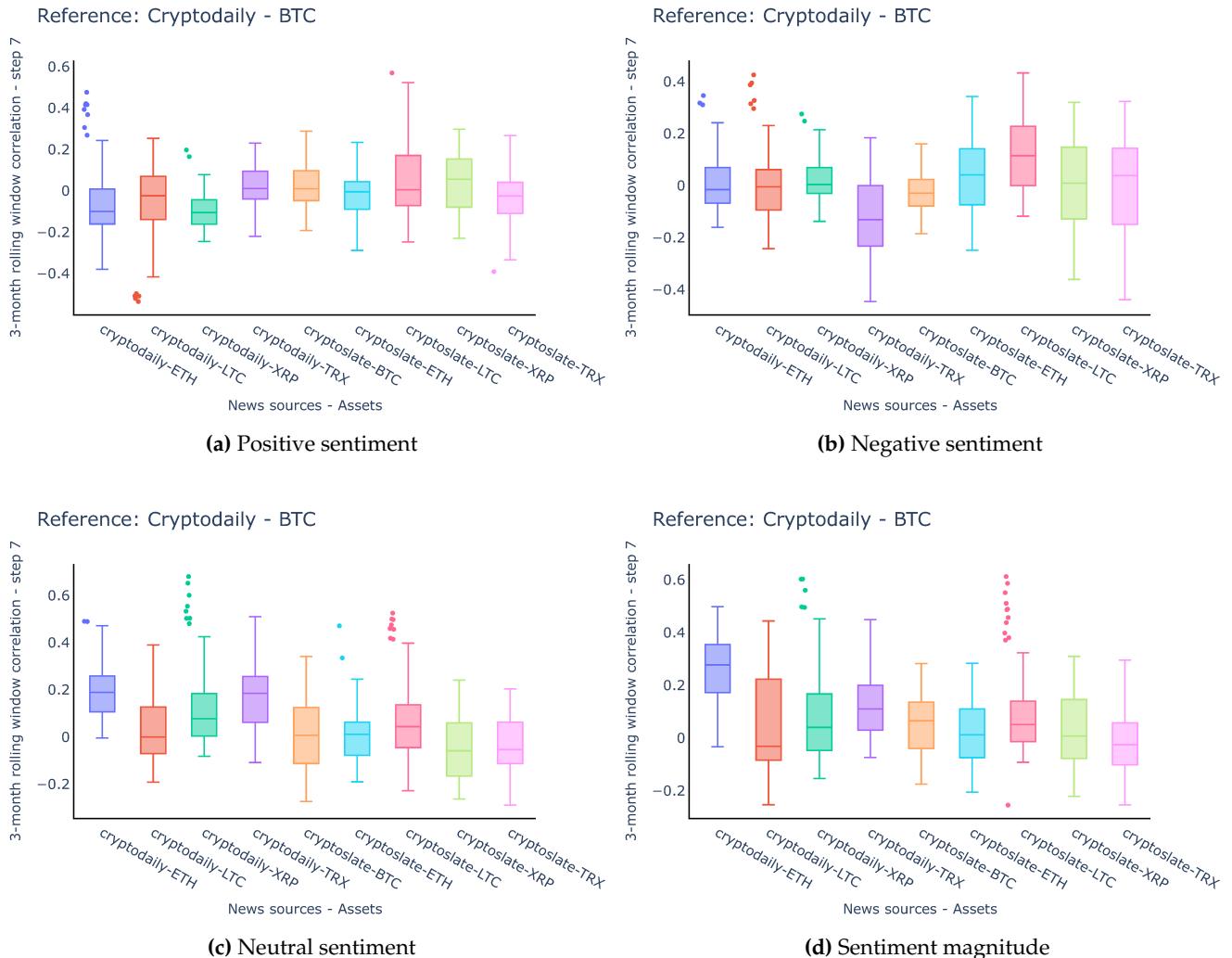


Figure 116. Rolling window correlation between entropy sentiment indices. The reference index is the sentiment index constructed from Cryptodaily articles on BTC.

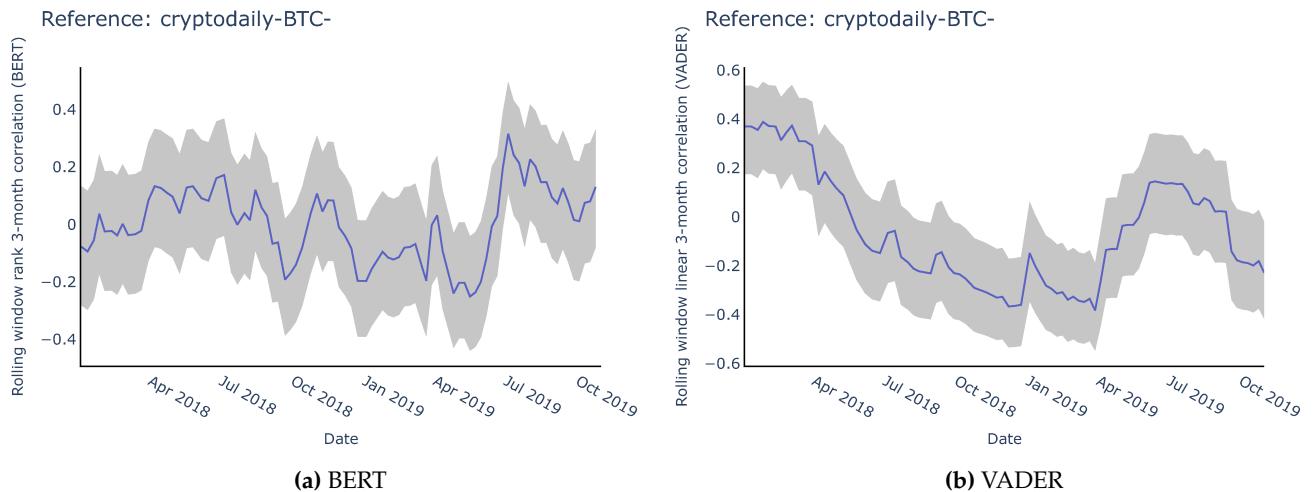


Figure 117. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

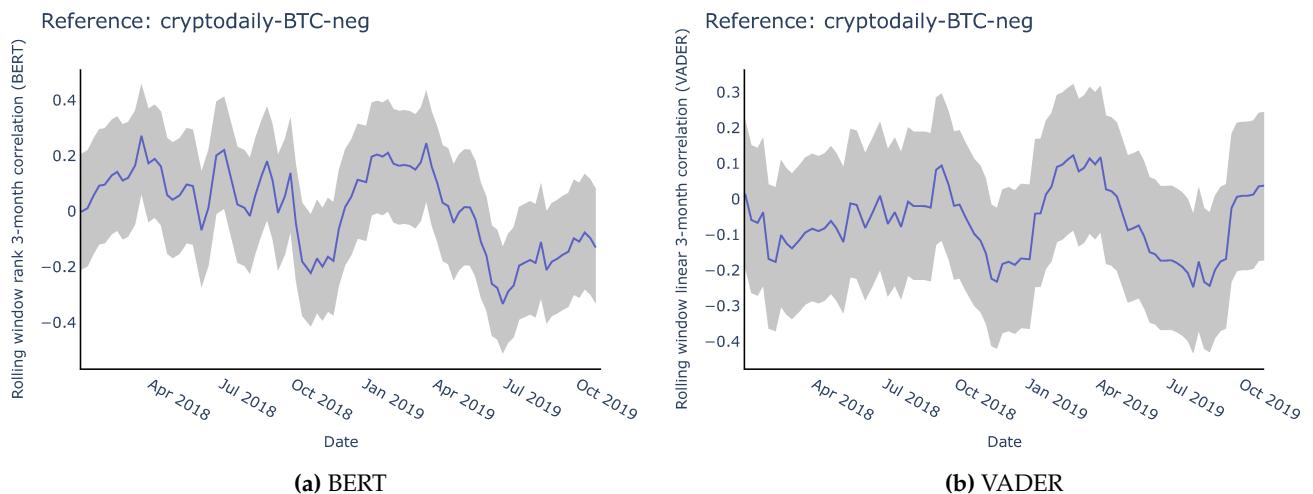


Figure 118. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

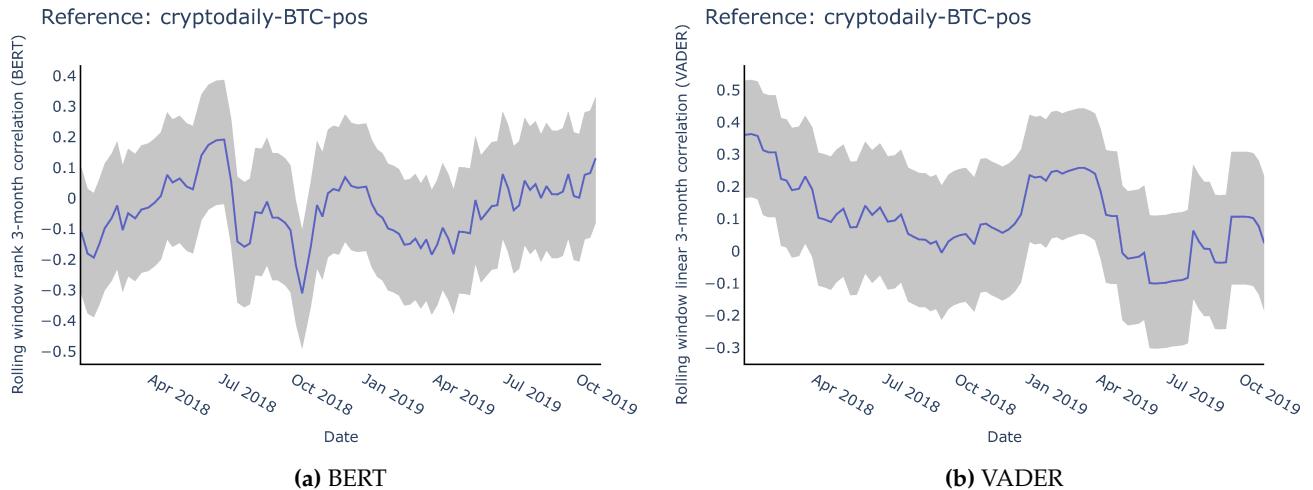


Figure 119. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

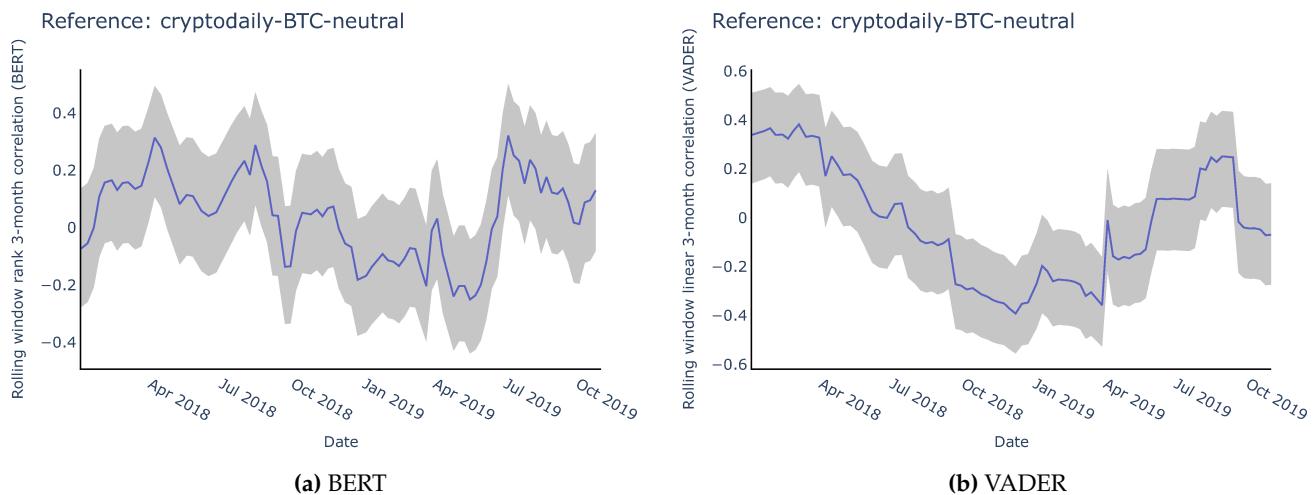


Figure 120. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

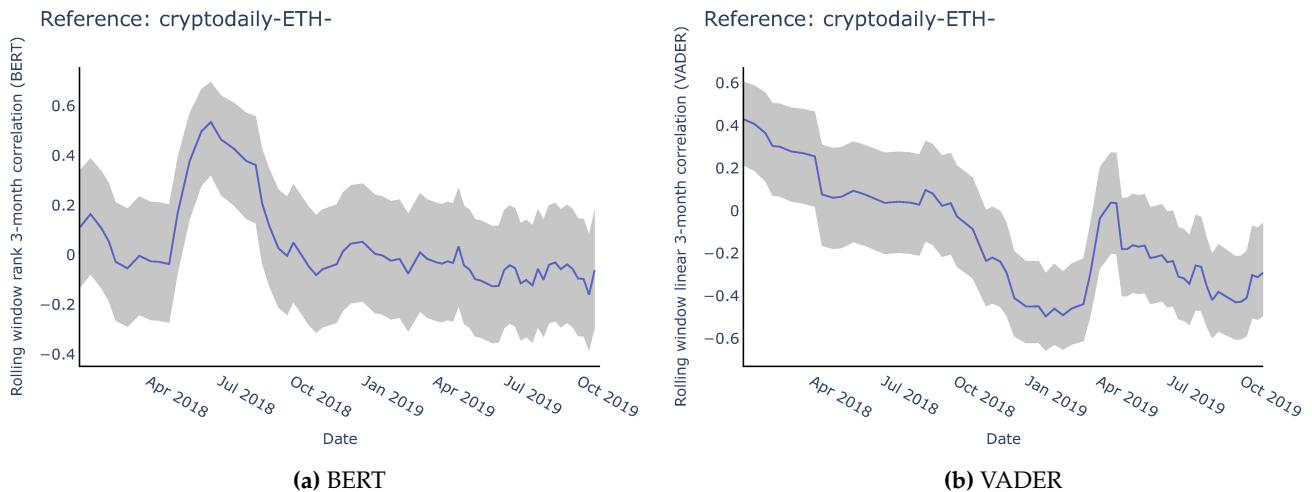


Figure 121. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

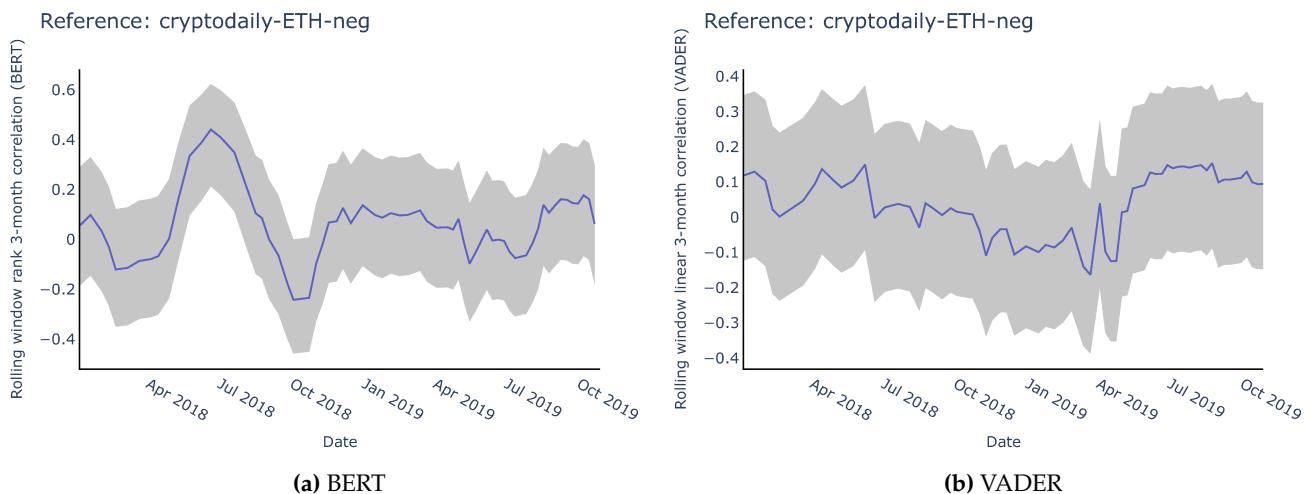


Figure 122. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

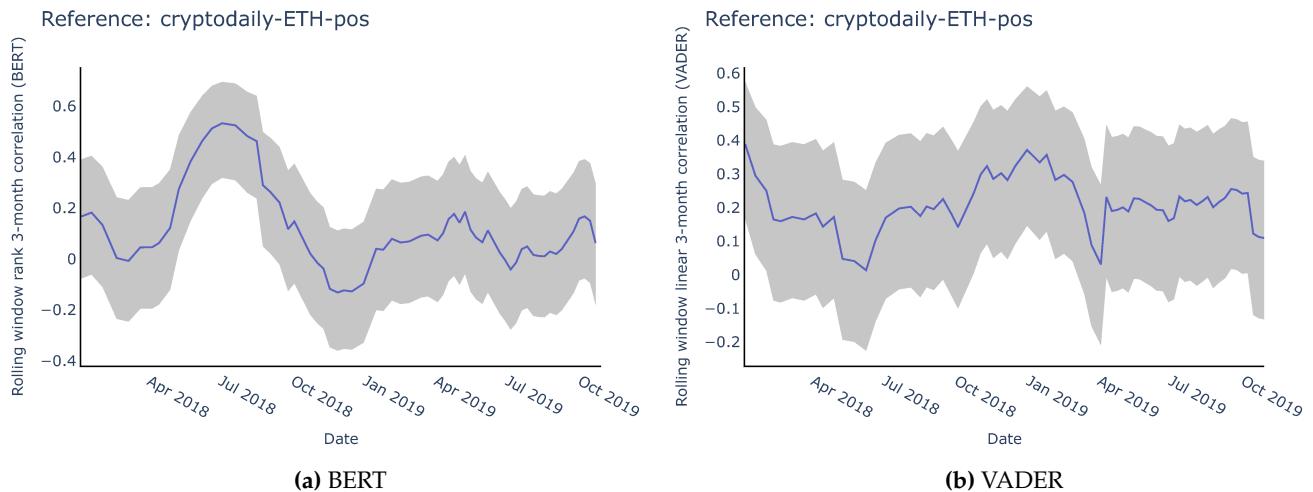


Figure 123. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

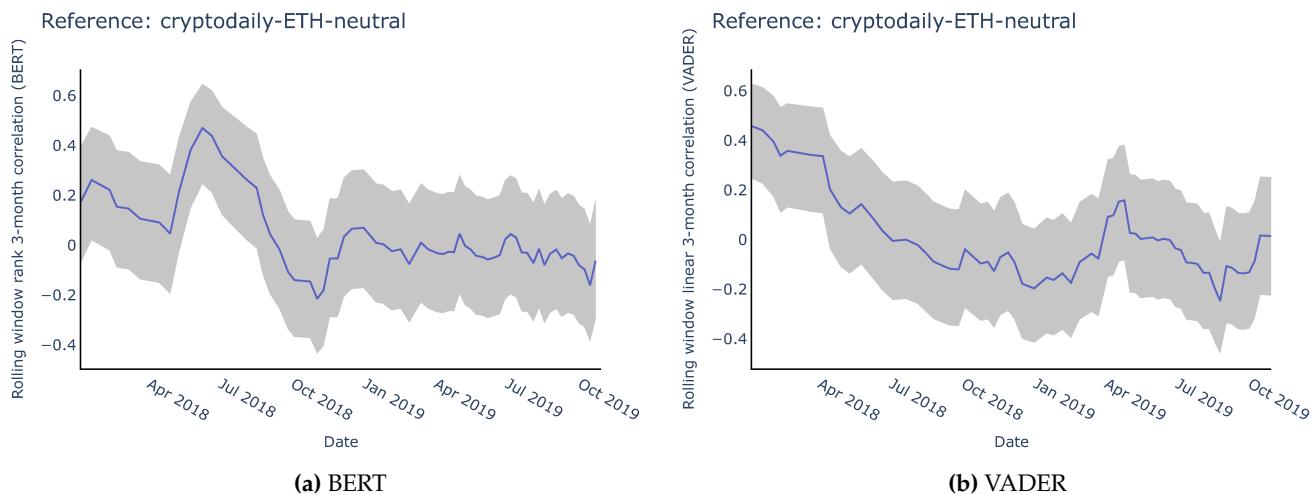


Figure 124. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

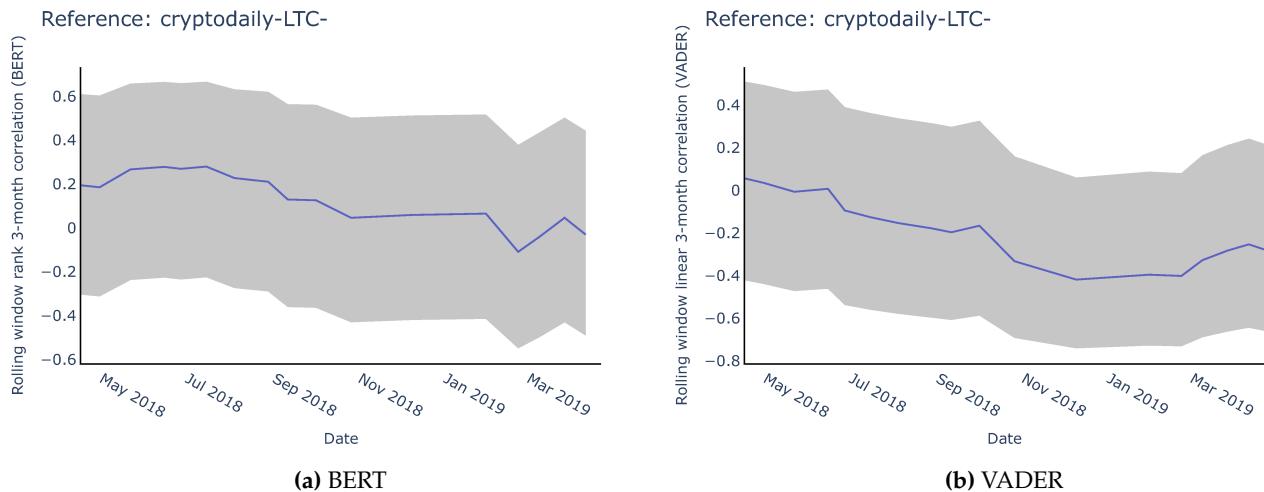


Figure 125. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

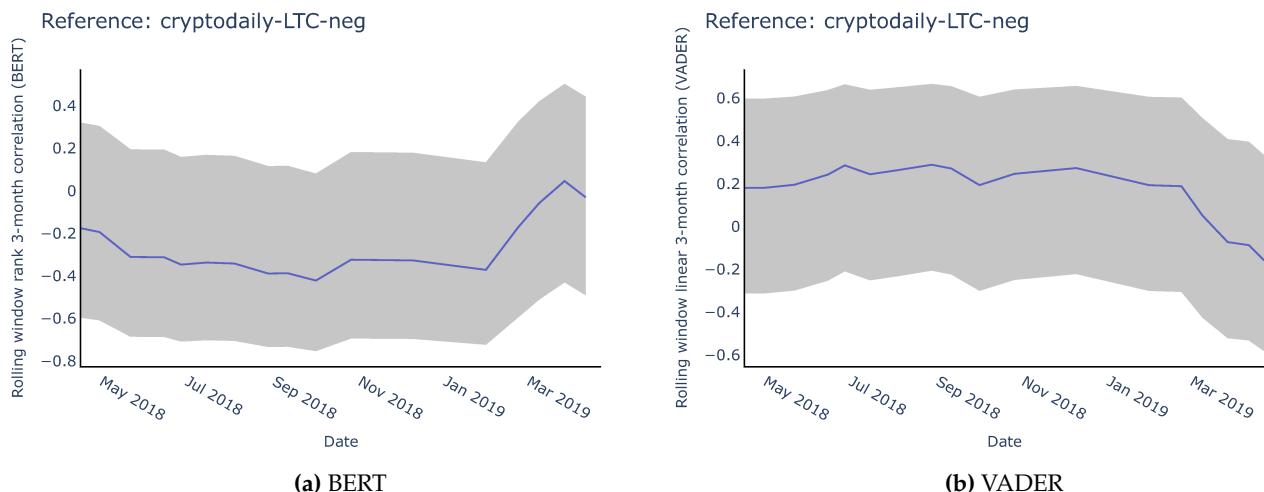


Figure 126. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

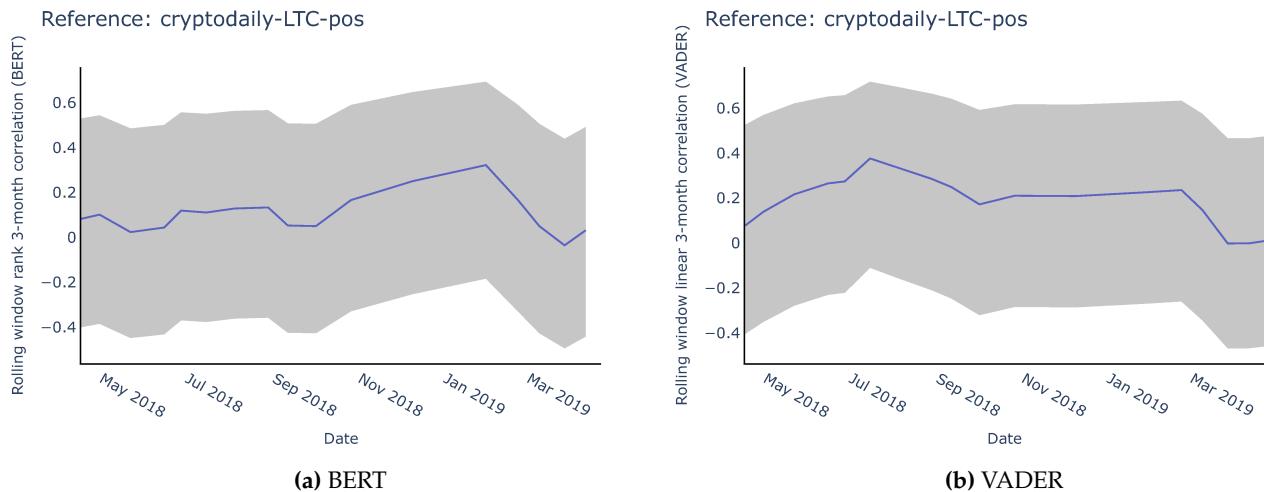


Figure 127. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

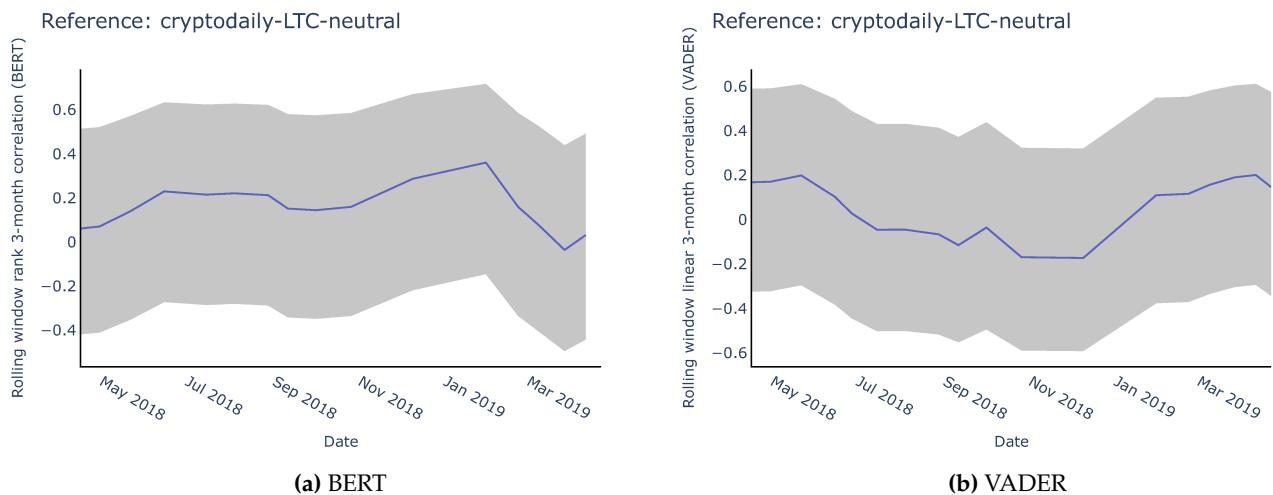


Figure 128. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

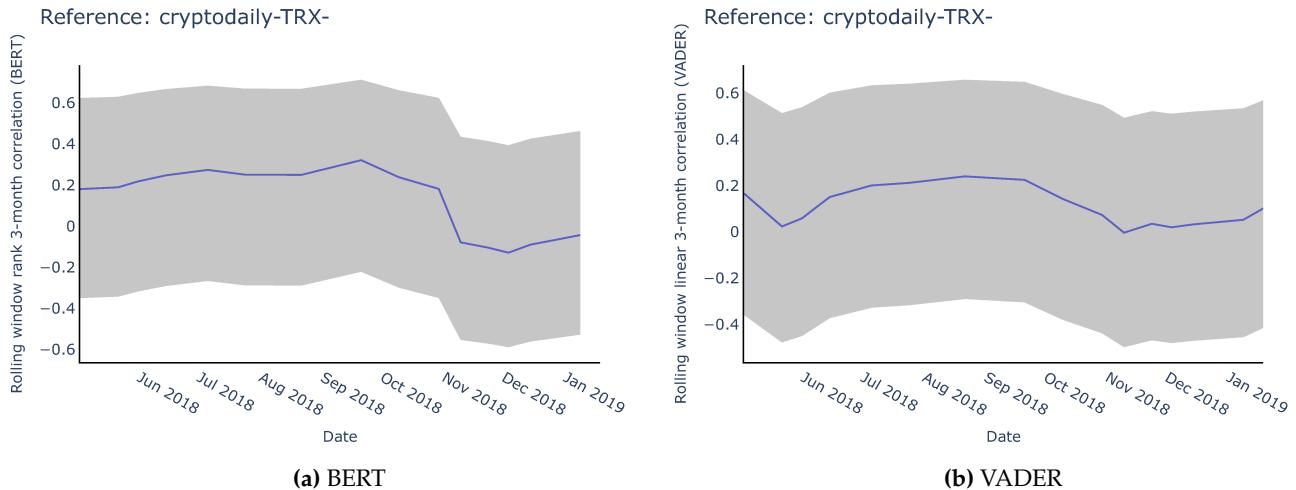


Figure 129. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

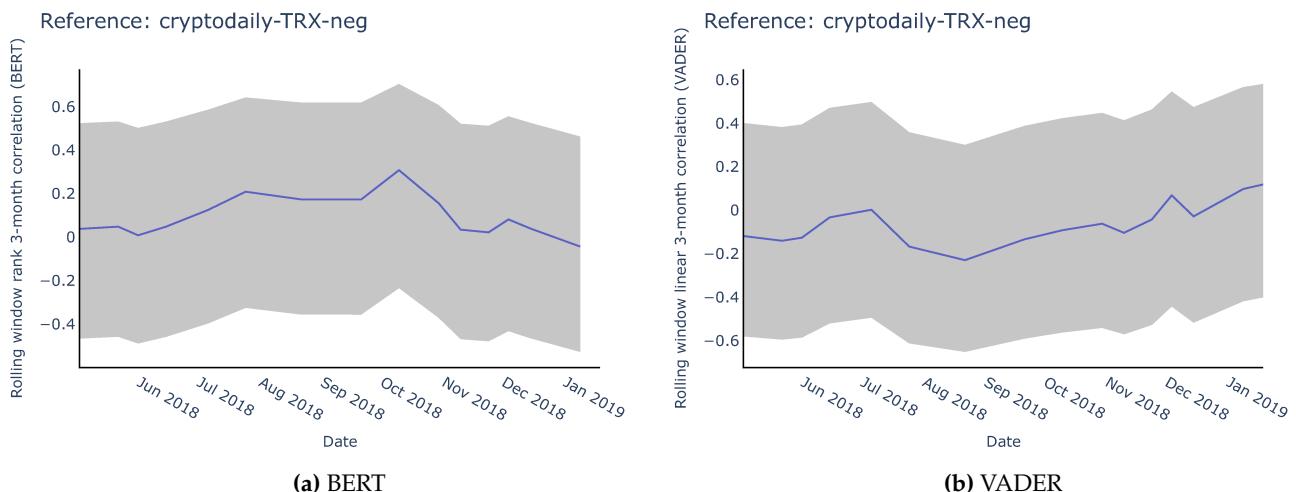


Figure 130. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

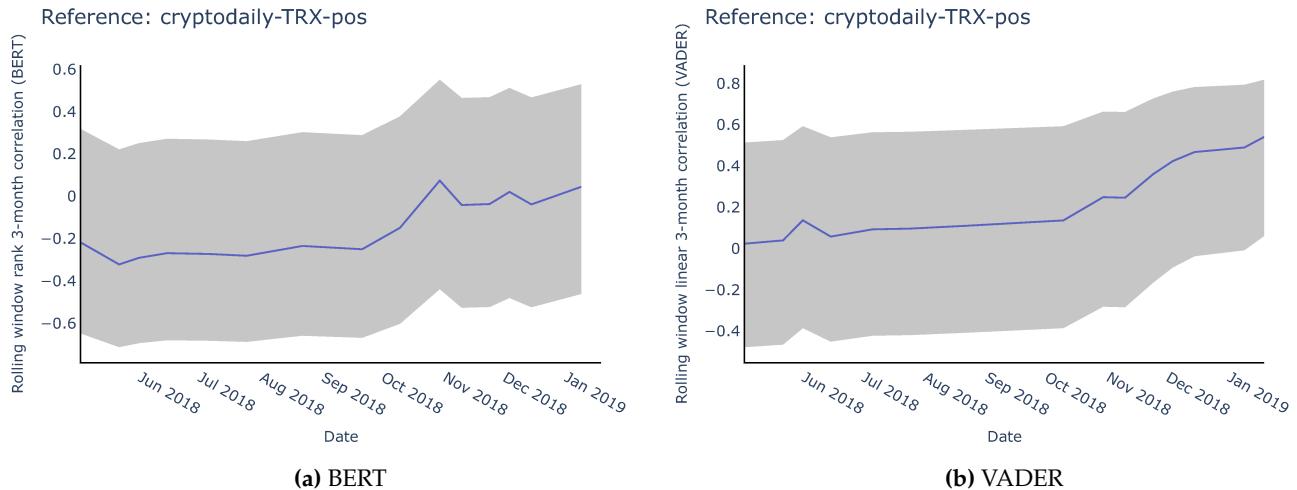


Figure 131. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

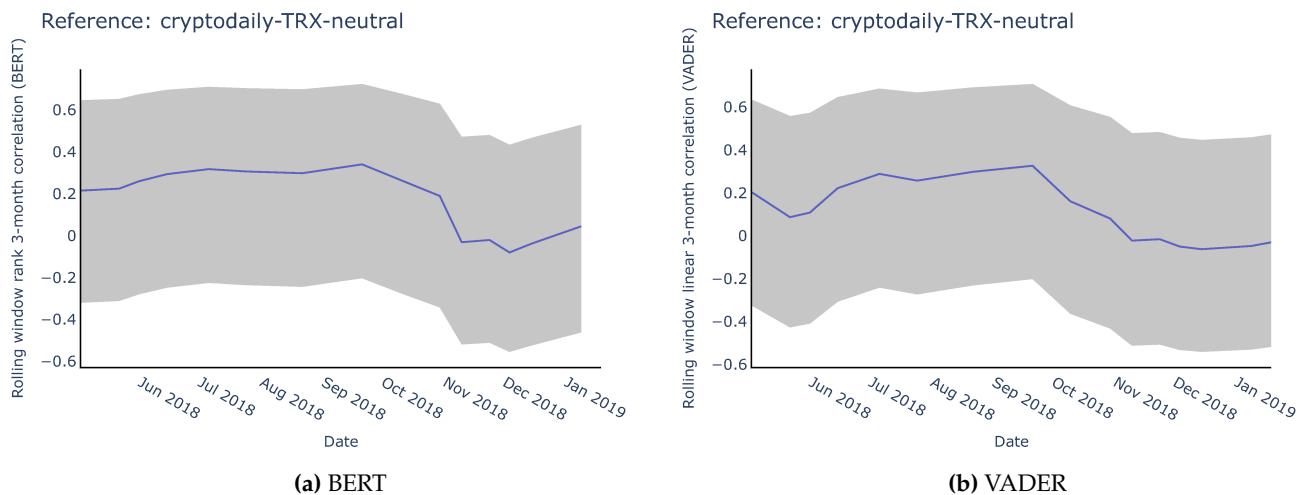


Figure 132. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

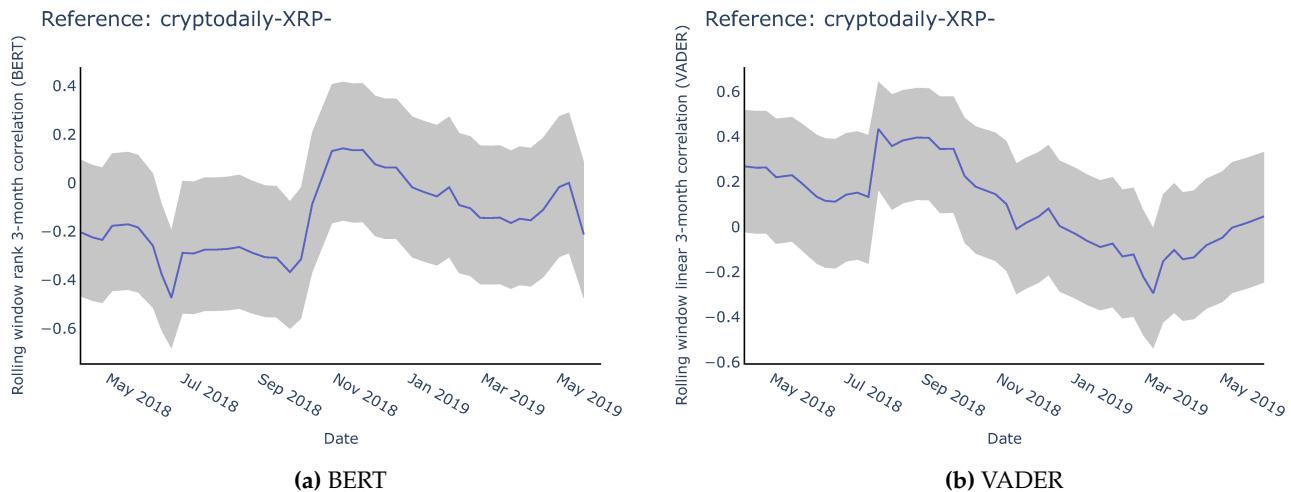


Figure 133. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

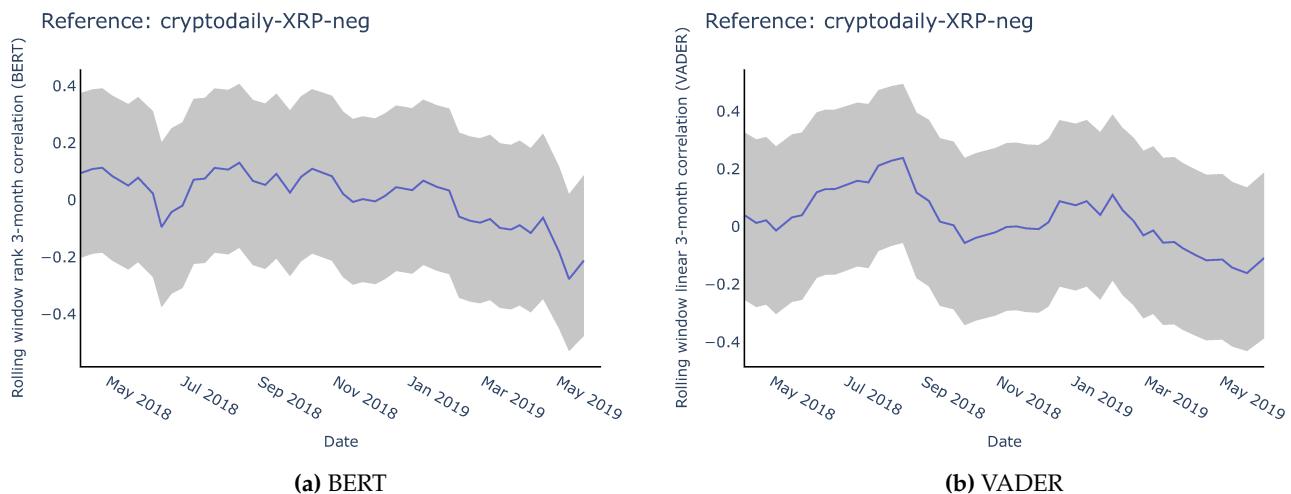


Figure 134. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

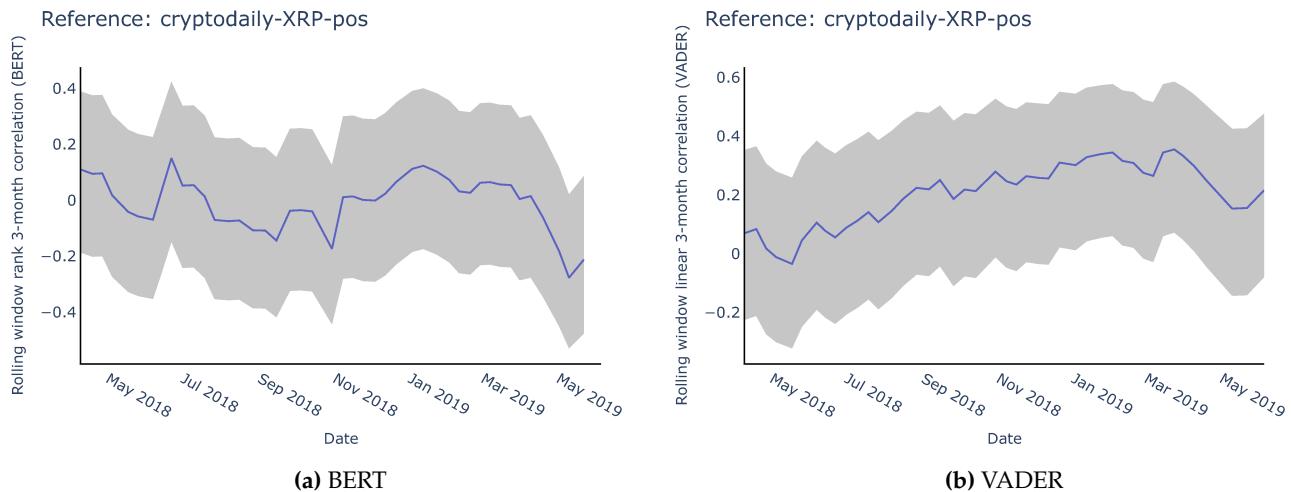


Figure 135. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

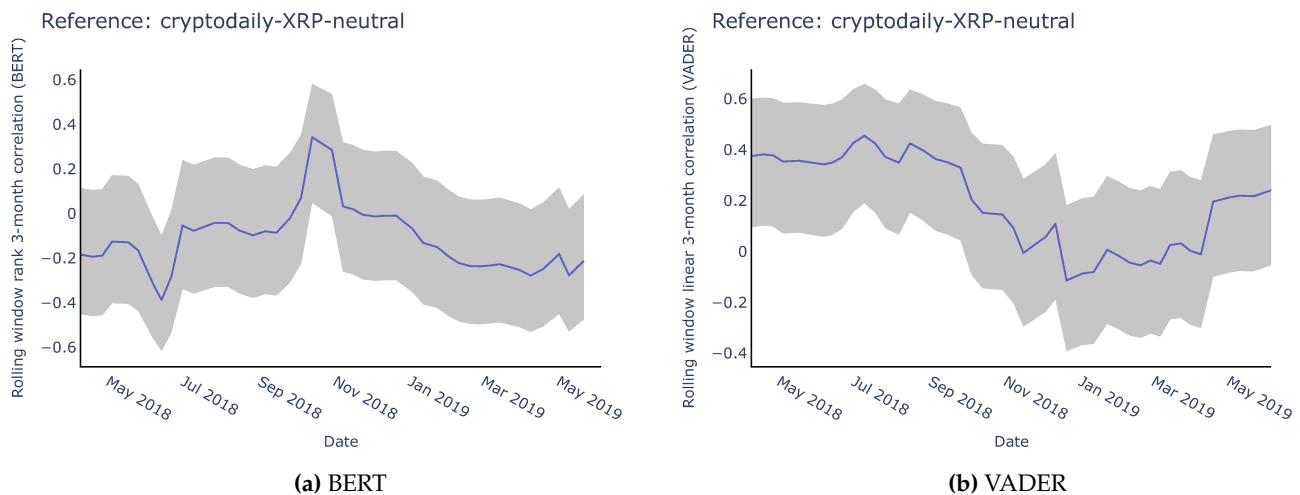


Figure 136. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

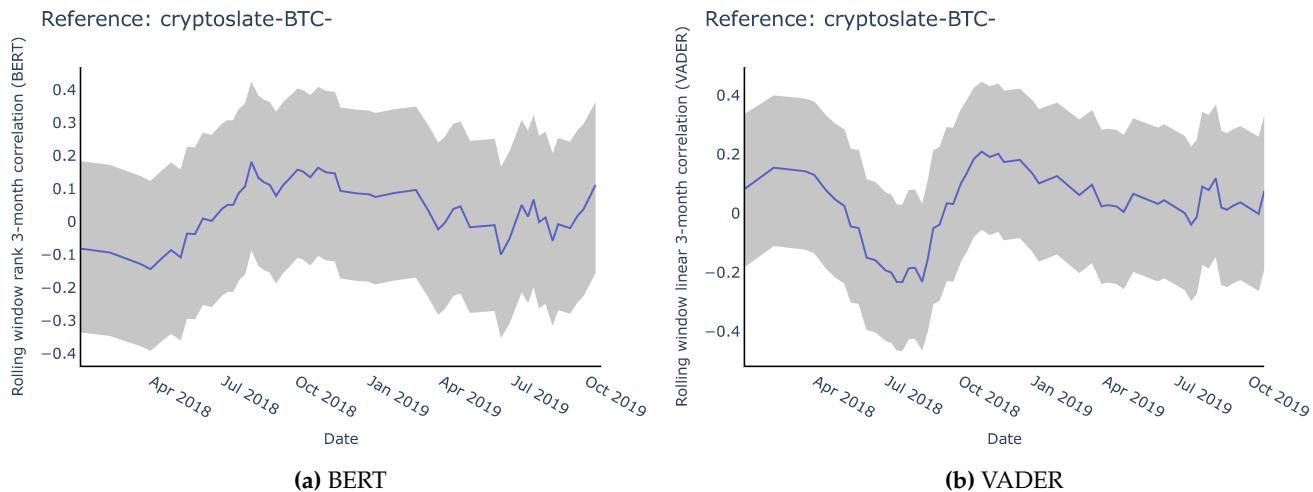


Figure 137. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

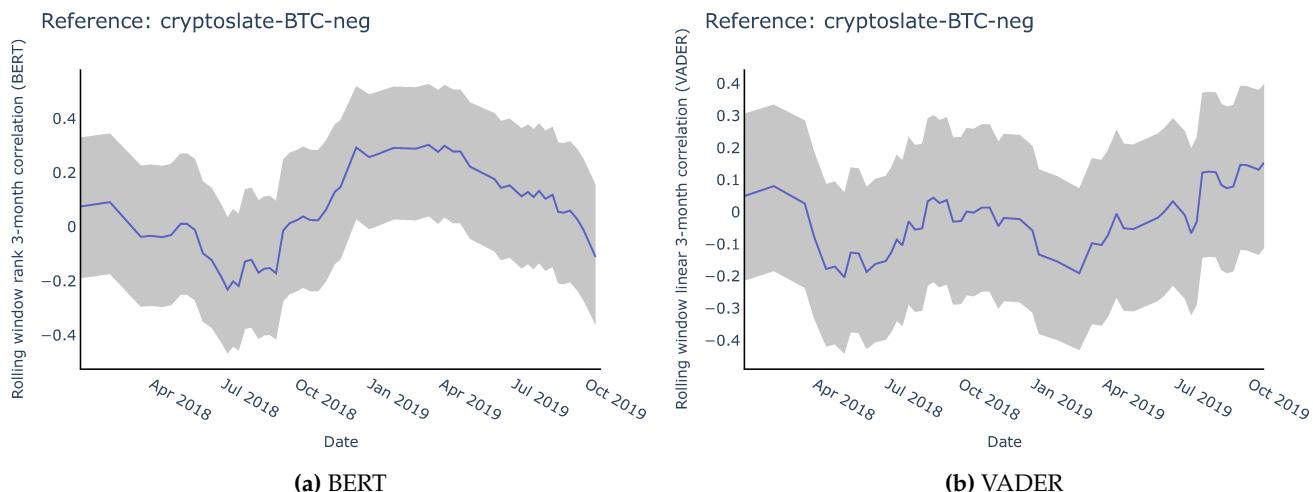


Figure 138. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

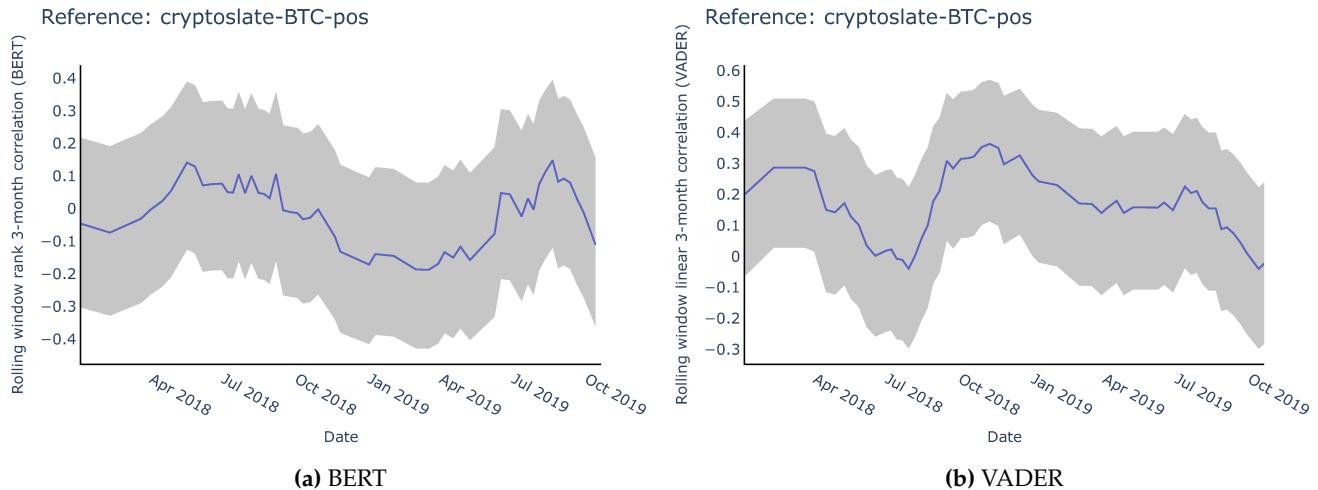


Figure 139. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

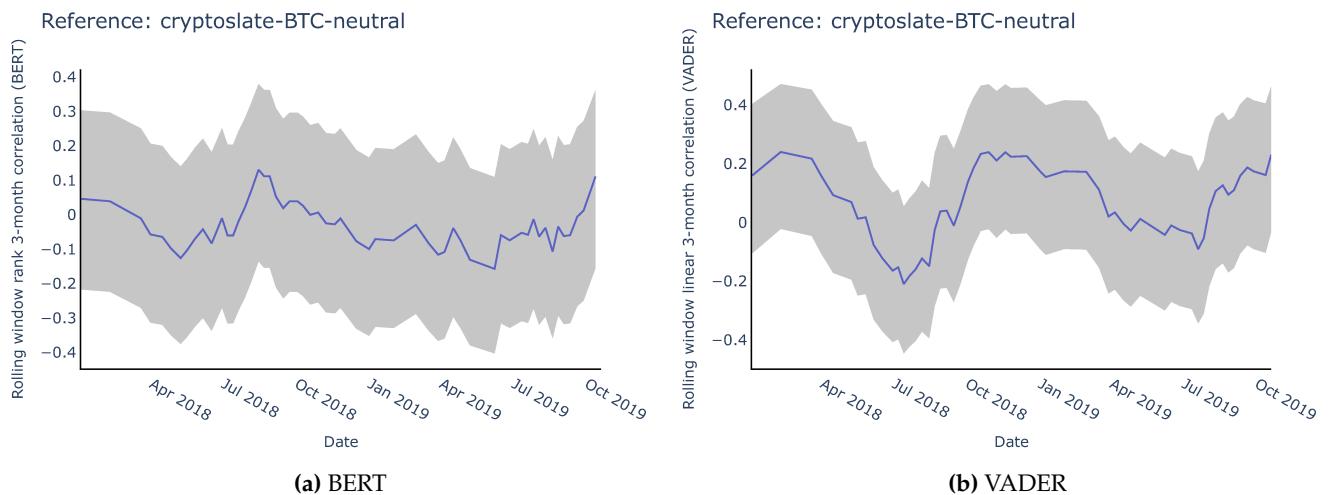


Figure 140. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

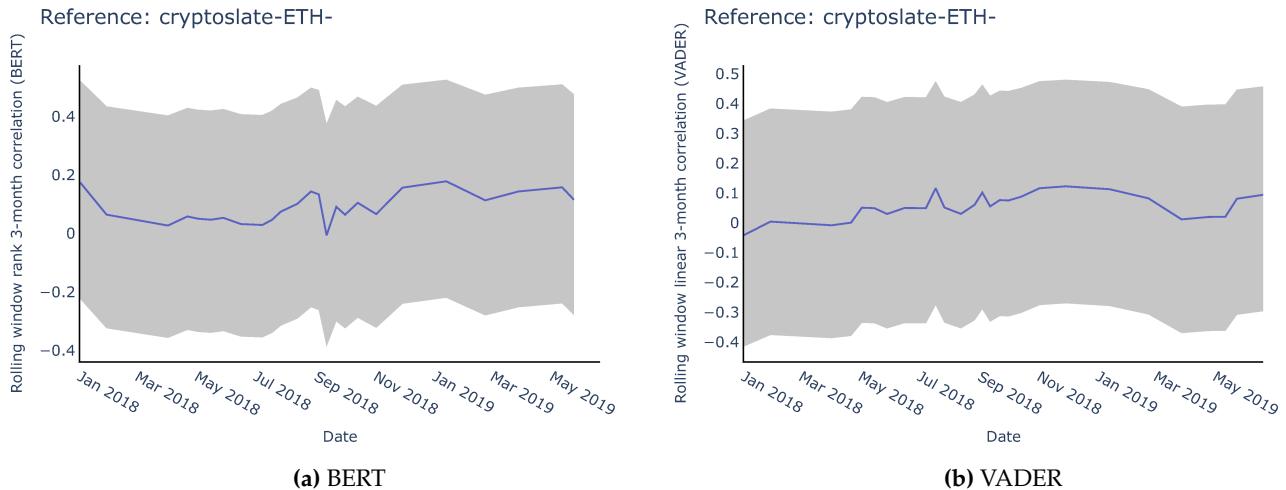


Figure 141. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

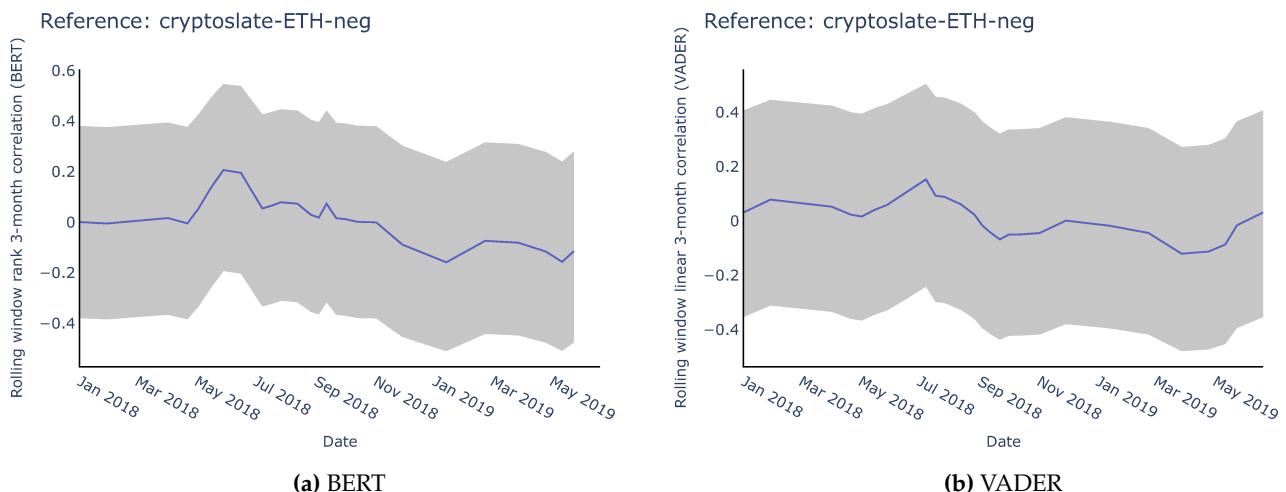


Figure 142. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

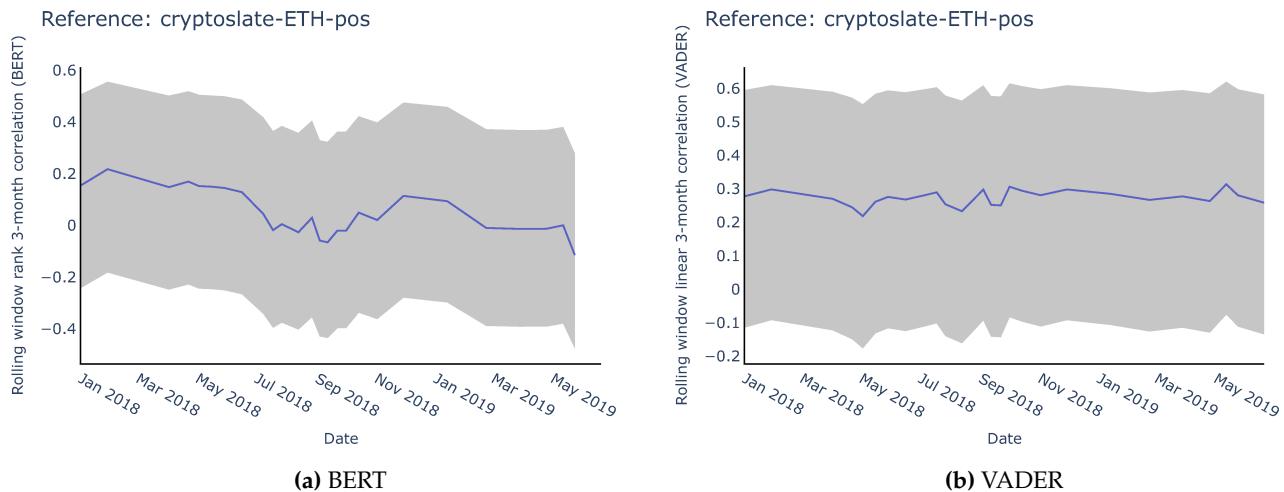


Figure 143. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

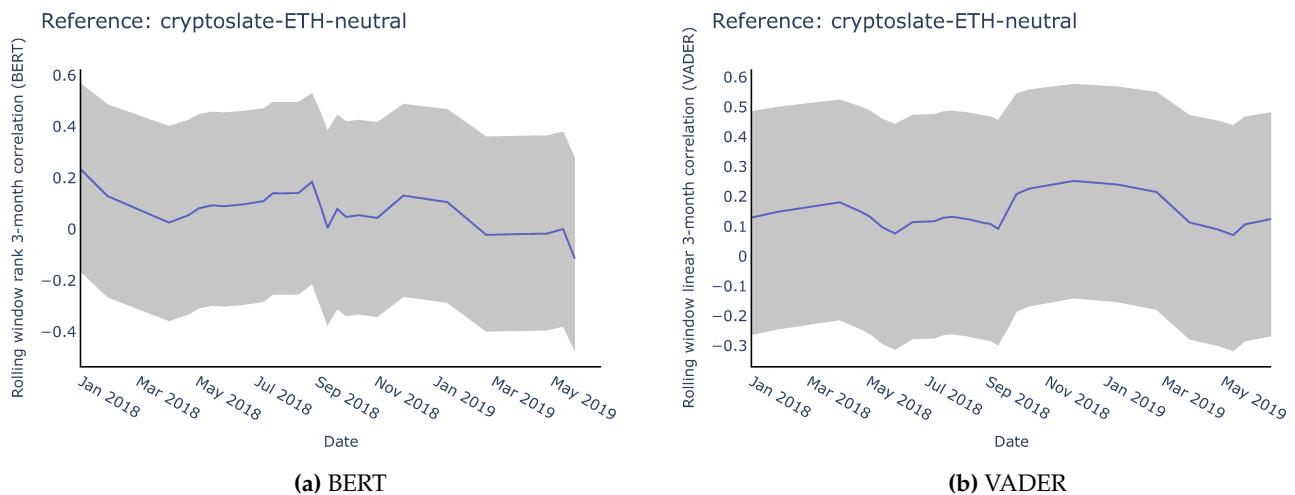


Figure 144. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

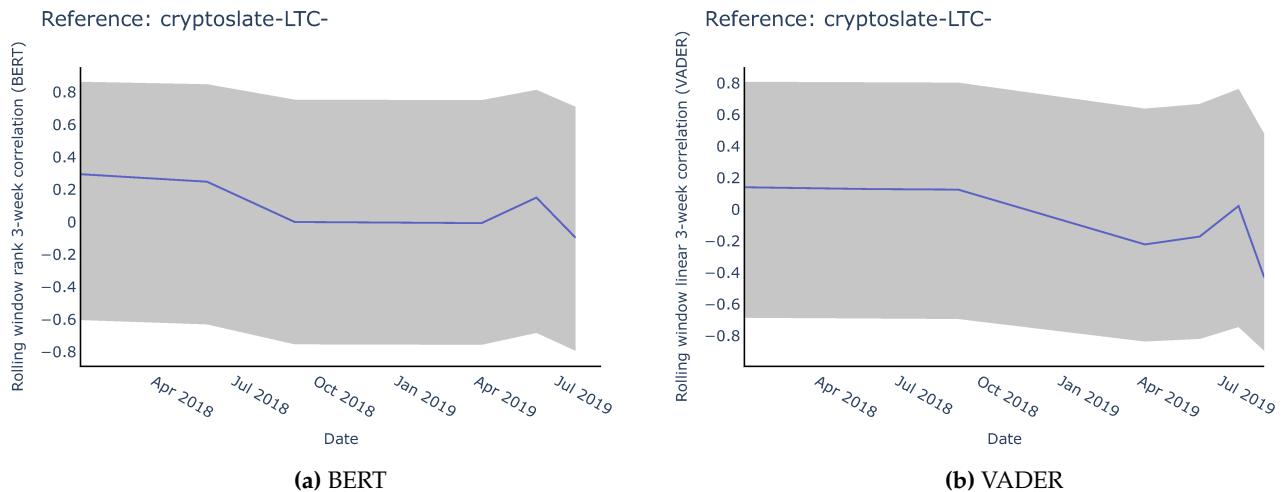


Figure 145. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

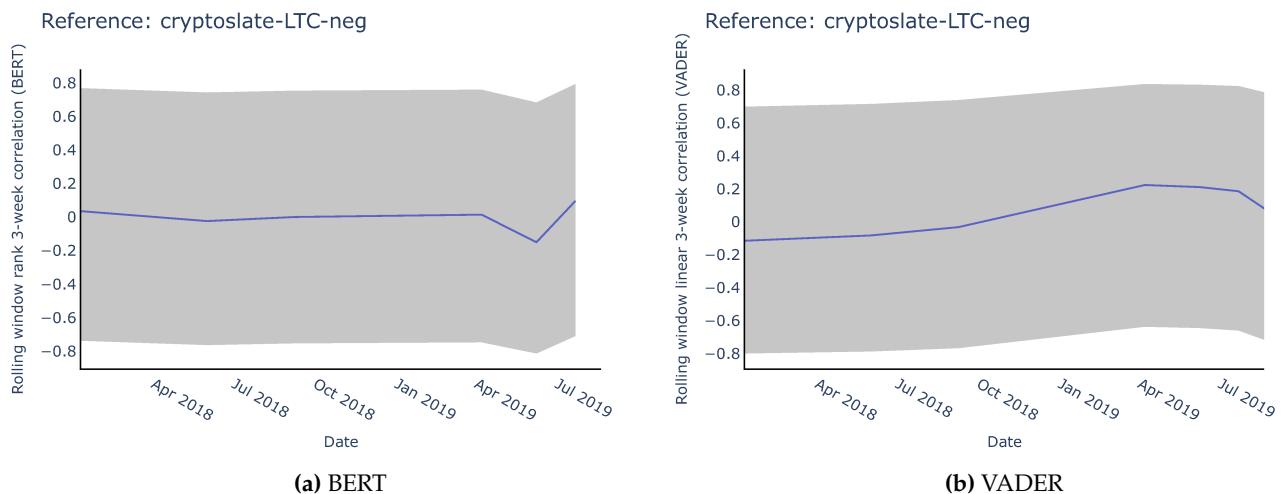


Figure 146. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

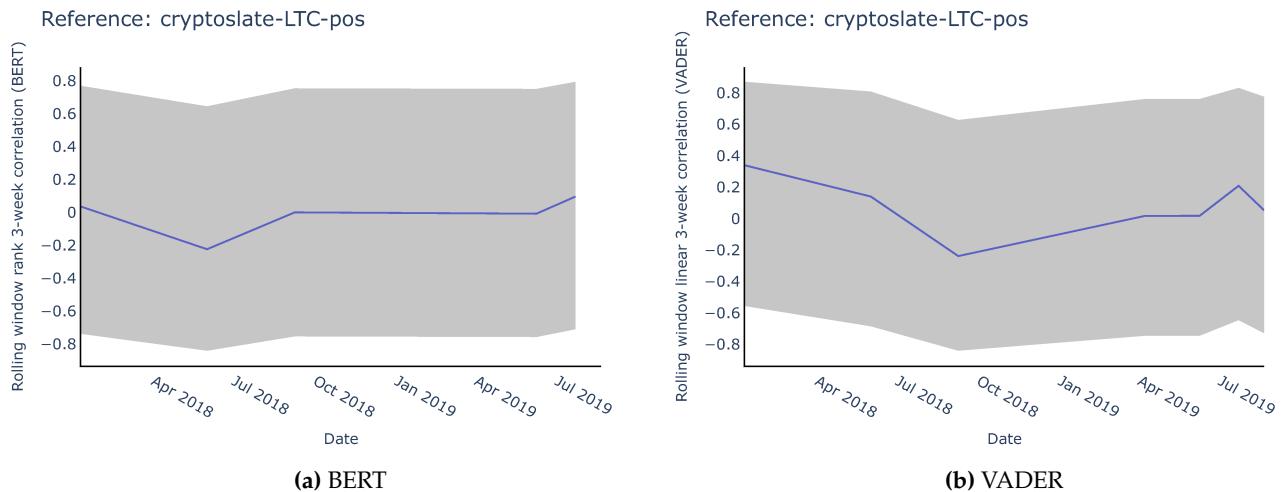


Figure 147. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

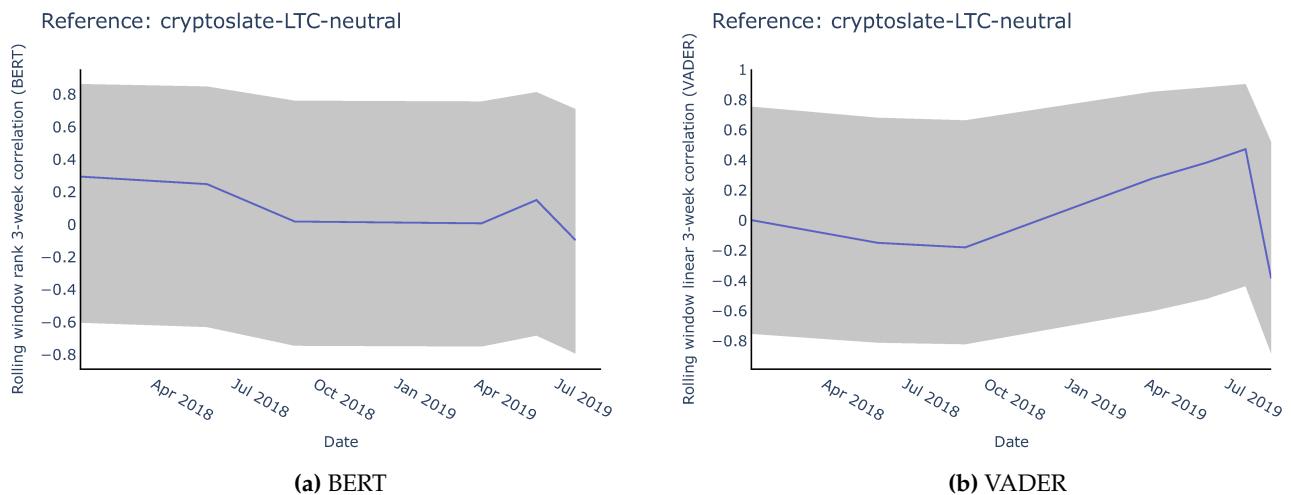


Figure 148. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

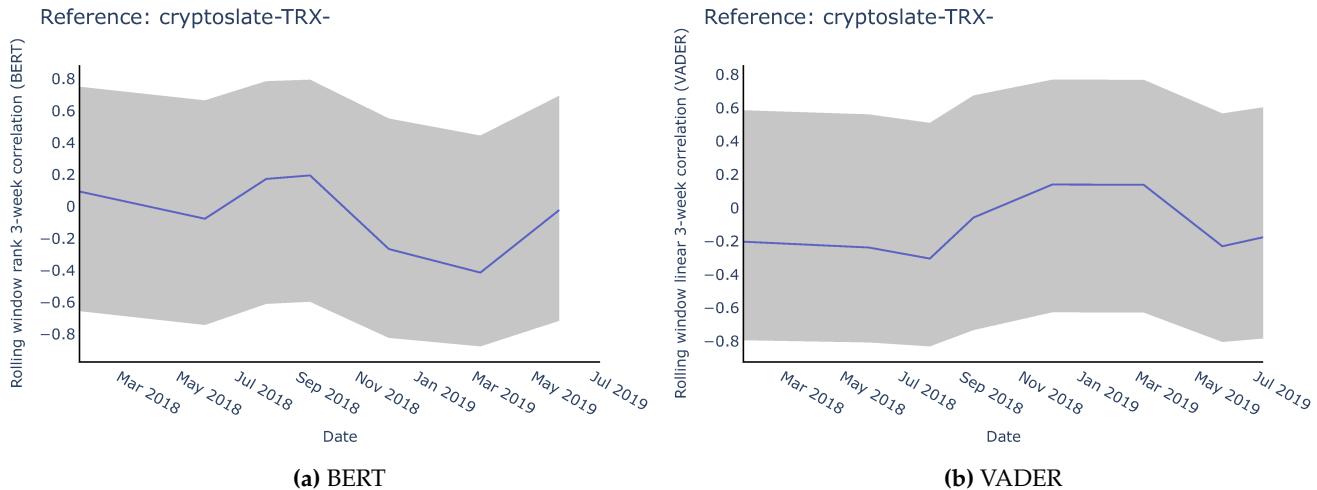


Figure 149. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

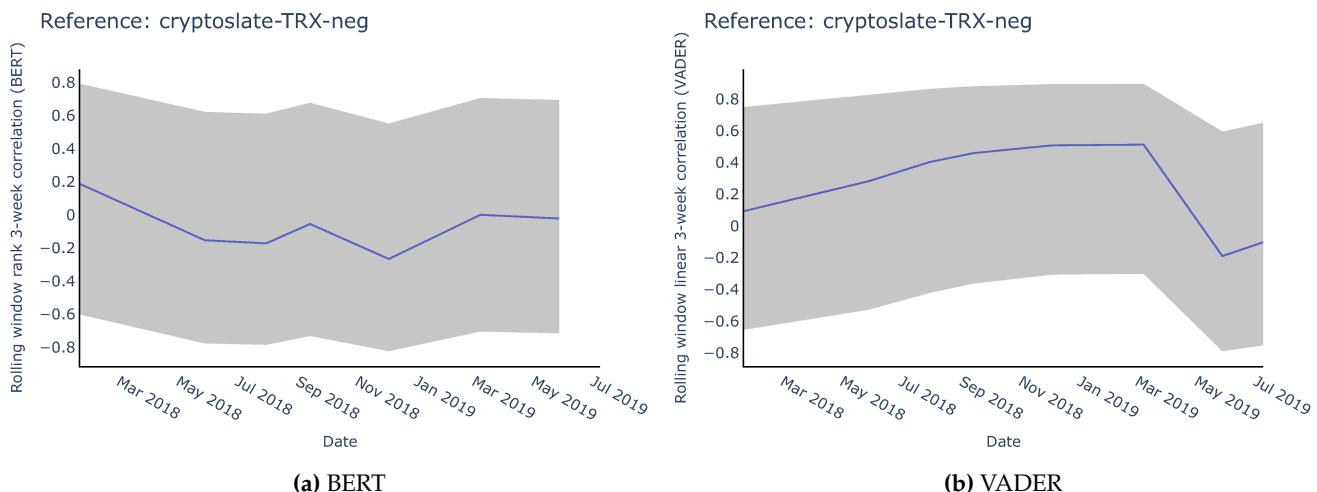


Figure 150. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

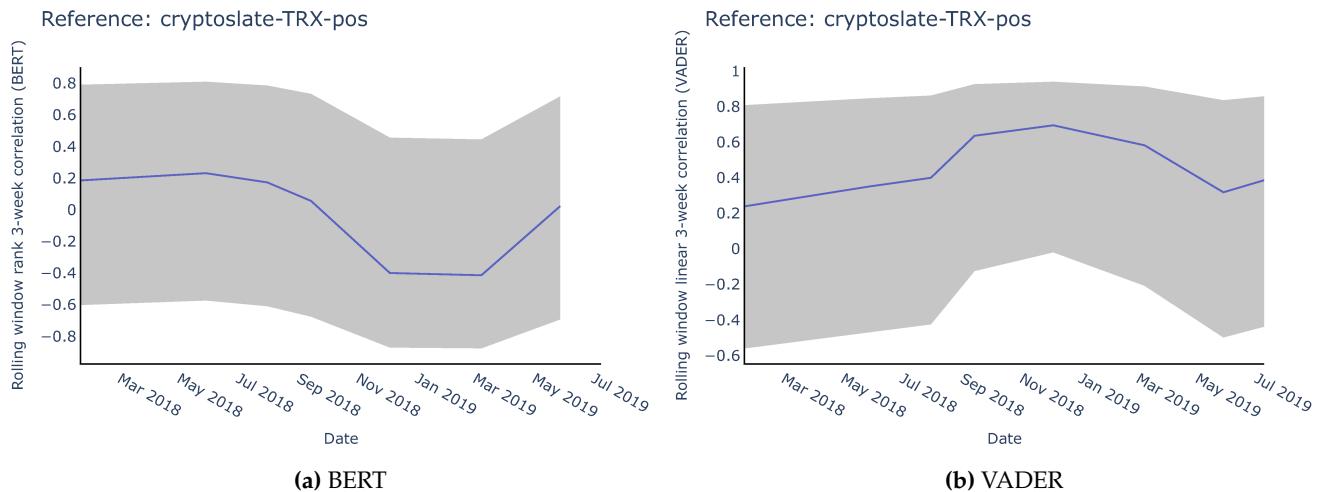


Figure 151. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

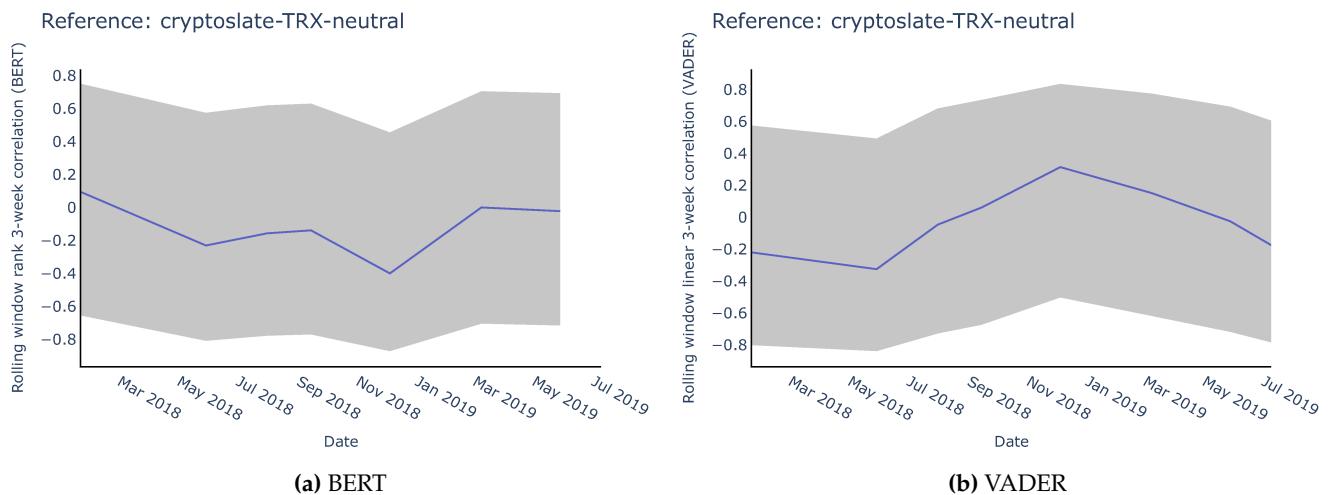


Figure 152. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

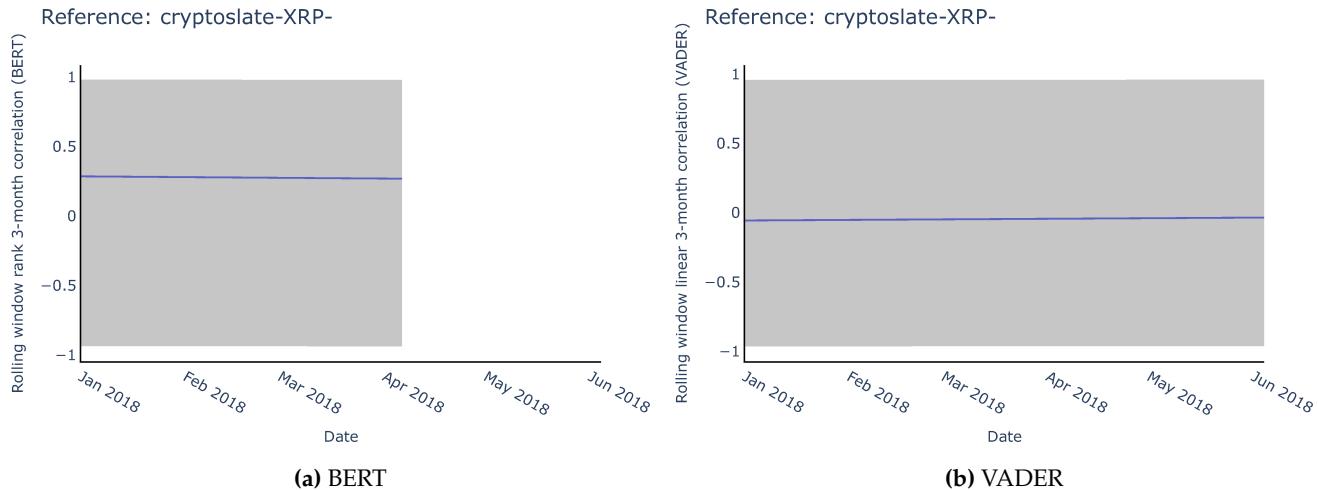


Figure 153. Rolling window cross-correlation between sentiment indices. The entropy index here does not distinguish between positive-negative sentiment words (sentiment magnitude).

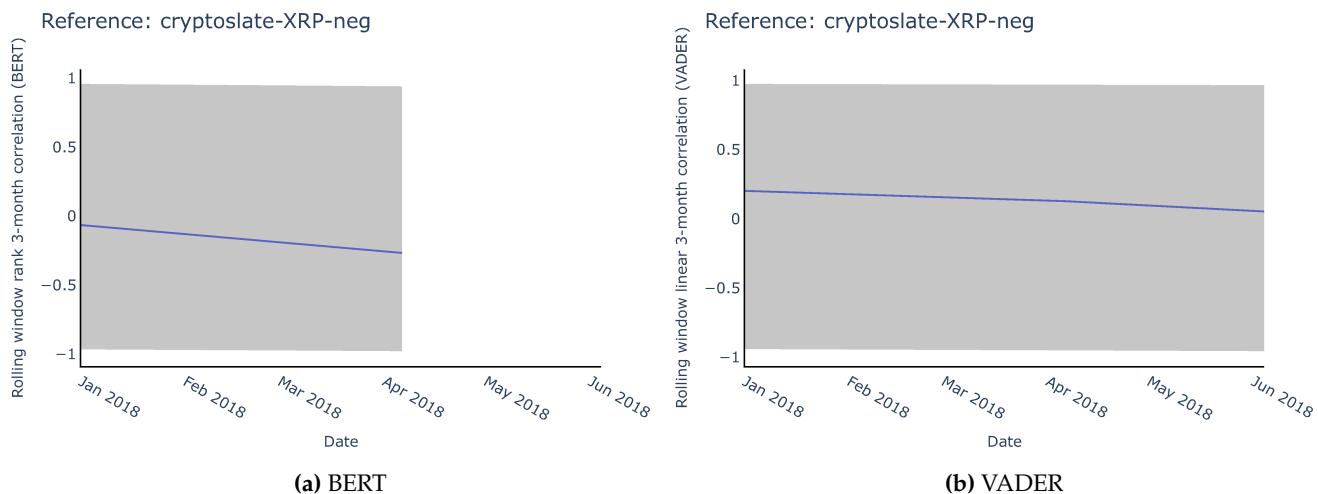


Figure 154. Rolling window cross-correlation between BERT/VADER and negative entropy sentiment index.

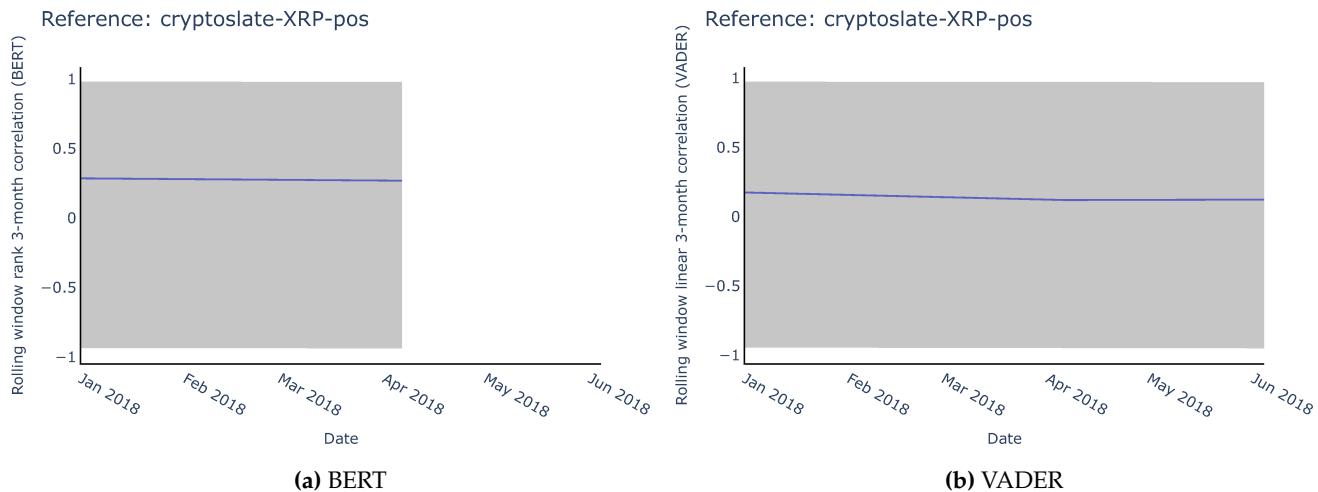


Figure 155. Rolling window cross-correlation between BERT/VADER and positive entropy sentiment index.

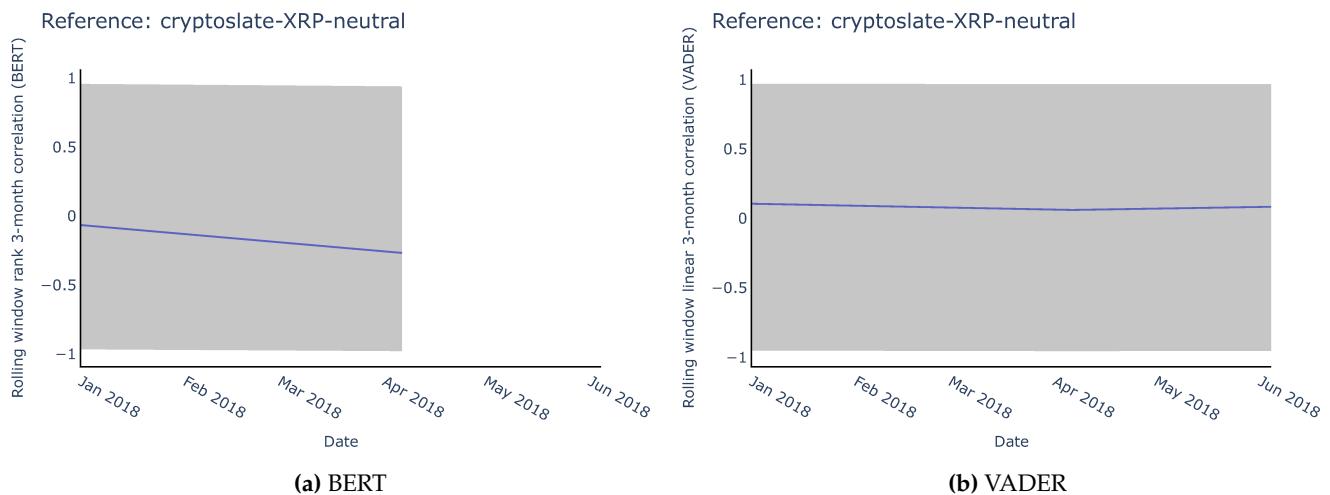


Figure 156. Rolling window cross-correlation between BERT/VADER and neutral entropy sentiment index.

9. Evidence of significant additional information in proposed sentiment index relative to BERT and VADER indices

In this section we investigate whether the sentiment indices constructed from the BERT and VADER models can be used as explanatory variables for our proposed entropy sentiment index. For this purpose, we fit distributed lag time-series regression models where the BERT and VADER indices are in the set of regressors, whereas the dependent variable is the entropy sentiment index. Subsequently, the significance of the model parameters relevant to the BERT and VADER covariates is assessed. The model structure we adopt is the following:

$$Y_t = \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \sum_{j=0}^{+\infty} \vec{\beta}_j^T \vec{X}_{t-j} + \epsilon_t, \quad (12)$$

where $\epsilon_t \sim N(0, \sigma^2)$, $\vec{\beta}_j = [\beta_j^B \ \beta_j^V]^T$, $\vec{X}_t = [X_t^B \ X_t^V]^T$ and the superscripts B, V stand for BERT and VADER respectively.

We draw attention to the fact that our goal with this model structure is not to develop a good model for prediction of Y_t but to investigate if the covariates from BERT and VADER have any explanatory power for Y_t , given a model for Y_t which we assume is good. We add an autoregressive component in the covariates to account for potential serial dependence in the dependent variable. If we do not account for that then we risk being misled by the output of the regression: if Y_t has serial dependence then the BERT and VADER covariates can appear to be significant for the dependence structure but that would not mean that they are explanatory for Y_t - it would be an artefact of the chosen model structure.

In order to obtain a parsimonious representation of the model thus reduce the number of parameters we have to estimate, we need to find a suitable functional expression for the coefficients $\vec{\beta}$. Note that $\vec{\beta}_j$ must form an L_2 sequence so that the sum of the corresponding term is square summable (provided X_t have finite moments) and the process converges. One option for the functional expression of $\vec{\beta}_j$ is to make them a geometric sequence ([Hill et al. 2001](#)) which is convenient as we can use the generator form of such sequences which has only two parameters to estimate:

$$\begin{aligned} \beta_j^B &= \beta^B \phi_B^j, \quad 0 < \phi_B < 1 \\ \beta_j^V &= \beta^V \phi_V^j, \quad 0 < \phi_V < 1 \end{aligned} \quad (13)$$

for each covariate correspondingly. The final form of our model then becomes:

$$\begin{aligned} Y_t &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \sum_{j=0}^{+\infty} \beta_j^B X_{t-j}^B + \sum_{j=0}^{+\infty} \beta_j^V X_{t-j}^V + \epsilon_t \\ &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \beta^B \sum_{j=0}^{+\infty} \phi_B^j X_{t-j}^B + \beta^V \sum_{j=0}^{+\infty} \phi_V^j X_{t-j}^V + \epsilon_t \end{aligned} \quad (14)$$

If our analysis using this model shows that Y_t is conditionally independent, or only weakly dependent on the covariates of BERT and VADER, then our sentiment index captures different information to these alternative models. In that case, it may be valuable, for example, to consider all indices together as components in a multimodal sentiment index model, where modality would correspond to the source, namely underlying model, of each component that captures a different sentiment aspect.

We fit the model in Equation 14 in rolling windows of length of three months with an one-month overlap (one month and one week correspondingly for Cryptoslate LTC, XRP, TRX due to lack of articles), where the regressors are the average-smoothed, z-scaled BERT and VADER indices.

We summarise (all assets put together) the results of the analysis by calculating the percentage of windows where BERT and VADER significantly ($p\text{-value} < 0.001$) contributed to explaining the sentiment index. We distinguish between the type of sentiment in the dependent variable, the daily summary used to construct the index (mean or median) and the smoothing window that was applied on the BERT covariate. We observe that the BERT and VADER covariates become significant when the mean is used to summarise the daily information, and only for the indices of the absolute sentiment strength, the positive and the neutral sentiments. For all parametrisations of smoothing window size or daily summary, BERT and VADER fail to explain the negative sentiment index. When the robust median is used to summarise the daily observations, primarily VADER and less so BERT (see table 105), can explain a small amount of the variation in the positive sentiment index, which is in agreement with the correlation and dependence measurements we obtained for the pair grid plots (Figure 96). In general we observe that the more we increase the amount of smoothing in BERT, the less it appears significant in explaining the entropy index. The sentiment that BERT extracts appears to be relevant to news articles with neutral sentiment, which we can explain with our previous observation that BERT captures information about sentiment magnitude but fails to distinguish between polarities due to domain specificity. On the other hand, VADER manages to explain a significant portion of the variability in the positive sentiment for specific cryptoassets. We conjecture this is due to the fact that the positive expression of sentiment is more universal than the negative and therefore the effect of the domain specificity is damped for some - especially the most popular and widely known - cryptoassets, as they may have been included in non-technical Tweets, which VADER had access to.

10. Two-stage estimation of an infinite lag distributed model

10.1. Model structure

In this section we will present the estimation procedure for the following infinite distributed lag model of the previous section:

$$\begin{aligned} Y_t &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \sum_{j=0}^{+\infty} \beta_j^B X_{t-j}^B + \sum_{j=0}^{+\infty} \beta_j^V X_{t-j}^V + \epsilon_t \\ &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \beta^B \sum_{j=0}^{+\infty} \phi_B^j X_{t-j}^B + \beta^V \sum_{j=0}^{+\infty} \phi_V^j X_{t-j}^V + \epsilon_t. \end{aligned} \tag{15}$$

First we will include only one of the additional covariates, say BERT. At times t and $t-1$ we have:

$$\begin{aligned} Y_t &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-i} + \sum_{j=0}^{+\infty} \beta_j^B X_{t-j}^B + \epsilon_t, \\ Y_{t-1} &= \alpha + \sum_{i=1}^p \gamma_i Y_{t-1-i} + \beta^B \sum_{j=0}^{+\infty} \phi_B^j X_{t-1-j}^B + \epsilon_{t-1} \end{aligned} \tag{16}$$

and multiplying the second row with the geometric decay rate ϕ_B :

$$\begin{aligned}
\phi_B Y_{t-1} &= \phi_B \alpha + \phi_B \sum_{i=1}^p \gamma_i Y_{t-1-i} + \beta^B \sum_{j=0}^{+\infty} \phi_B^{j+1} X_{t-1-j}^B + \phi_B \epsilon_{t-1} \\
&= \alpha \phi_B + \phi_B \epsilon_{t-1} + \gamma_1 \phi_B Y_{t-2} + \gamma_2 \phi_B Y_{t-3} + \cdots + \gamma_p \phi_B Y_{t-1-p} \\
&\quad + \beta^B \phi_B X_{t-1} + \beta^B \phi_B^2 X_{t-2} + \beta^B \phi_B^3 X_{t-3} + \cdots
\end{aligned} \tag{17}$$

Subtracting the expressions in equations 16 (for Y_t) and 17 we obtain:

$$Y_t - \phi_B Y_{t-1} = \alpha(1 - \phi_B) + \epsilon_t - \phi_B \epsilon_{t-1} + \sum_{i=1}^p \gamma_i (Y_{t-i} - \phi_B Y_{t-1-i}) + \beta^B X_t^B, \tag{18}$$

and equivalently we have:

$$Y_t = \alpha(1 - \phi_B) + \phi_B Y_{t-1} + \sum_{i=1}^p \gamma_i (Y_{t-i} - \phi_B Y_{t-1-i}) + \beta^B X_t^B + \epsilon_t - \phi_B \epsilon_{t-1}. \tag{19}$$

If we then work in the same way for the VADER covariate we obtain:

$$Y_t = \alpha(1 - \phi_V) + \phi_V Y_{t-1} + \sum_{i=1}^p \gamma_i (Y_{t-i} - \phi_V Y_{t-1-i}) + \beta^V X_t^V + \epsilon_t - \phi_V \epsilon_{t-1}, \tag{20}$$

and after adding the last two models, we have for the model with both covariates:

$$\begin{aligned}
2Y_t &= \alpha(2 - \phi_B - \phi_V) + (\phi_B + \phi_V) Y_{t-1} + \sum_{i=1}^p \gamma_i [2Y_{t-i} - (\phi_B + \phi_V) Y_{t-1-i}] \\
&\quad + \beta^B X_t^B + \beta^V X_t^V + 2\epsilon_t - (\phi_B + \phi_V) \epsilon_{t-1},
\end{aligned} \tag{21}$$

or equivalently:

$$Y_t = \alpha(1 - \phi) + \phi Y_{t-1} + \sum_{i=1}^p \gamma_i (Y_{t-i} - \phi Y_{t-1-i}) + \beta^B X_t^B + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}, \tag{22}$$

where we have substituted $\phi = \frac{\phi_B + \phi_V}{2}$.

The final regression model can be estimated with a least squares procedure. Note that we cannot use ordinary least squares (OLS) as it would produce inconsistent estimators since the error term is autocorrelated and therefore correlated with the lagged dependent variable Y_{t-1} . We will instead estimate the model in a two-step procedure using instrumental variables (IV) regression. Because we do not aim to obtain a good model for Y_t for prediction purposes, to simplify our estimation we keep only one lag of the dependent variable in the regression and set $\gamma_i = 0$ for $i = 1, \dots, p$:

$$Y_t = \alpha(1 - \phi) + \phi Y_{t-1} + \beta^B X_t^B + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}. \tag{23}$$

The two steps of the regression are detailed below.

10.2. Stage I

In this first step we remove the autocorrelation from the independent variable by regressing the following:

$$Y_t = \mu_0 + \mu_1 Y_{t-1} + \epsilon_t. \quad (24)$$

We can estimate the parameters of the previous AR(1) model by ordinary least squares, and given those we obtain the raw residuals E_t^y . This first regression will be our reference model for the regressions in Stage II; if we improve the fit in terms of AIC ([Akaike 1974](#)) by adding covariates with statistical significance, then the added covariates will be successful in explaining some of Y_t .

10.3. Stage II

In this second stage we will use instrumental variables regression to remove the correlation between the error term and Y_{t-1} . To construct the instrumental variable we have a number of possible regression models which we discuss next.

Before constructing the instrumental variable we can check whether we have captured the autocorrelation structure with the AR(1) model. To achieve this we can check the distribution of the residuals. If the errors are normally distributed we have a good model already, otherwise we could capture the additional structure by fitting a higher order AR(p) model. We choose to keep the AR(1) model however, assuming we have explained some of the autocorrelation structure, and add the BERT and VADER covariates to explain the variation in Y_t .

We will next try a range of regression models for the instrumental variable and E_t^y and choose the combination that provides both an instrumental variable that is independent from the error term, and a statistically significant fit to E_t^y .

10.3.1. Model I: BERT covariate for Y_t , IV regression with BERT

We construct the IV as follows:

$$\tilde{E}^y_{t-1} = \tilde{\mu}_0 + \tilde{\mu}_1 X_{t-1}^B + \epsilon_{t-1}. \quad (25)$$

We perform a t -test on the regression parameters and compute the IV \tilde{E}^y_{t-1} using only those that are statistically significant. Then we conduct the following OLS regression for E_t^y :

$$E_t^y = \alpha(1 - \phi) + \phi \tilde{E}^y_{t-1} + \beta^B X_t^B + \epsilon_t - \phi \epsilon_{t-1}. \quad (26)$$

At this stage we want first to evaluate the quality of the IV and then the quality of the fit with respect to X^B . To evaluate the instrumental variable we test for autocorrelation in the error terms; if they are not autocorrelated then we have successfully constructed an IV that is not correlated with the errors and the use of OLS was appropriate. We test for error autocorrelation using the Breusch-Godfrey test (LM test for autocorrelation, [Breusch \(1978\)](#)), for which the null hypothesis is the lack of serial correlation of any order up to p . If we have evidence to accept the null then we proceed to test the parameters for statistical significance, otherwise we consider this fit invalid - we would need to construct a different IV, for example by adding more structure to the corresponding

model. If they are significant, we next assess the model by means of the AIC.

The procedure we just described for Model I is followed for all subsequent models, therefore we will next present only the different model structures we used.

10.3.2. Model II: VADER covariate for Y_t , IV regression with VADER

IV regression:

$$\tilde{E}^y_{t-1} = \tilde{\mu}_0 + \tilde{\mu}_1 X_{t-1}^V + \epsilon_{t-1}. \quad (27)$$

E_t^y regression:

$$E_t^y = \alpha(1 - \phi) + \phi \tilde{E}^y_{t-1} + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}. \quad (28)$$

10.3.3. Model III: BERT and VADER covariates for Y_t , IV regression with BERT

IV regression:

$$\tilde{E}^y_{t-1} = \tilde{\mu}_0 + \tilde{\mu}_1 X_{t-1}^B + \epsilon_{t-1}. \quad (29)$$

E_t^y regression:

$$E_t^y = \alpha(1 - \phi) + \phi \tilde{E}^y_{t-1} + \beta^B X_t^B + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}. \quad (30)$$

10.3.4. Model IV: BERT and VADER covariates for Y_t , IV regression with VADER

IV regression:

$$\tilde{E}^y_{t-1} = \tilde{\mu}_0 + \tilde{\mu}_1 X_{t-1}^V + \epsilon_{t-1}. \quad (31)$$

E_t^y regression:

$$E_t^y = \alpha(1 - \phi) + \phi \tilde{E}^y_{t-1} + \beta^B X_t^B + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}. \quad (32)$$

10.3.5. Model V: BERT and VADER covariates for Y_t , IV regression with BERT and VADER

IV regression:

$$\tilde{E}^y_{t-1} = \tilde{\mu}_0 + \tilde{\mu}_1 X_{t-1}^B + \tilde{\mu}_2 X_{t-1}^V + \epsilon_{t-1}. \quad (33)$$

E_t^y regression:

$$E_t^y = \alpha(1 - \phi) + \phi \tilde{E}^y_{t-1} + \beta^B X_t^B + \beta^V X_t^V + \epsilon_t - \phi \epsilon_{t-1}. \quad (34)$$

Finally, we compare the AIC results for the appropriate models and choose the best among those.

10.4. Regression outputs and fitting details

We present the details of the successful fits for the distributed lag models, as well as comment on the distribution of the residuals of the model of Equation 24.

In Figures 159 and 160 we see which of the models we used for the instrumental variable (IV) regression in Stage II was selected most often as the best to obtain the IV. We observe that when using the mean to summarise the daily n -gram sentiment, the Stage II model with VADER prevails regardless of the smoothing window we had used for BERT. When using the median as daily summary, we observe that the smoothing window we used for BERT significantly affects which model is selected for the IV regression. With a short time window of 1 week, BERT is chosen as the appropriate regressor for the IV, however as the smoothing window increases BERT loses its ability to produce a good IV on its own. It is remarkable that for a long time window of six months the regression model with BERT is again dominant for the IV regression. We attribute this to the fact that BERT captures the magnitude of the sentiment and therefore better expresses the trend of the IV when smoothed with a long window.

When fitting the regression model in Stage I we assume normality of the residuals, yet this does not have to be true as they may follow a different, e.g. heavy-tailed, distribution. We therefore inspect quantile-quantile (Q-Q) plots per regression window and note that the majority of them do match the normality assumption. There are few that seem to be better matched by a t-Student distribution but are so few that we do not expect that a change for heavy tailed noise in the regressions we performed will change our observations about the ability of BERT and VADER to explain the entropy index. From that analysis it is interesting to see that heavy tails and kurtosis in the Q-Q plots correspond to abnormal events in the Bitcoin price movement that our entropy index reacts to. We refer to Figure 157 where we show the Q-Q plot for a Stage I fit to the window starting on February 5, 2018. We remark that on January 7, 2018 there was a significant peak in the BTC price at 16,735 USD and on February 6, a month later, we had a 65% drop in the BTC price. The proposed entropy sentiment index reacted to this plummeting of the price as we understand from the Q-Q plots. The indices from BERT and VADER, however do not appear to react - they remain mostly neutral during that time period (see Figure 158).

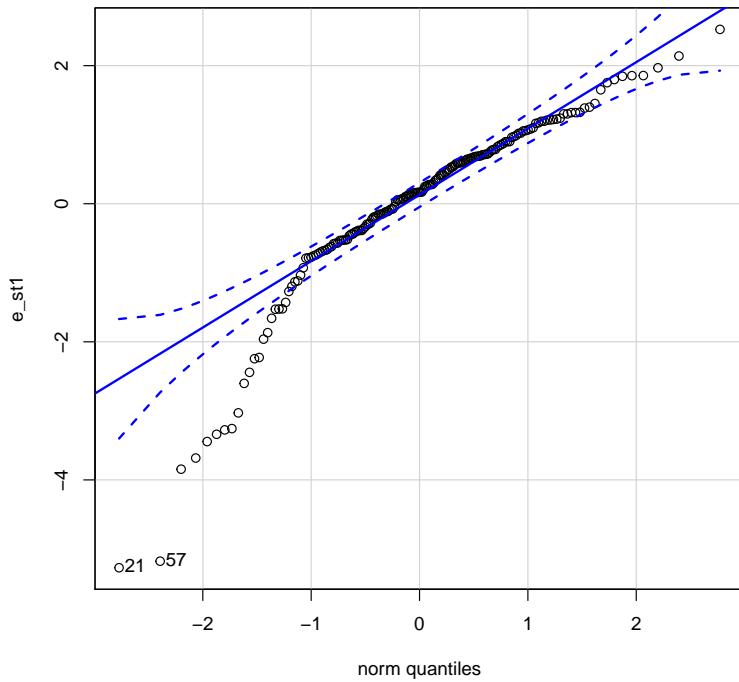
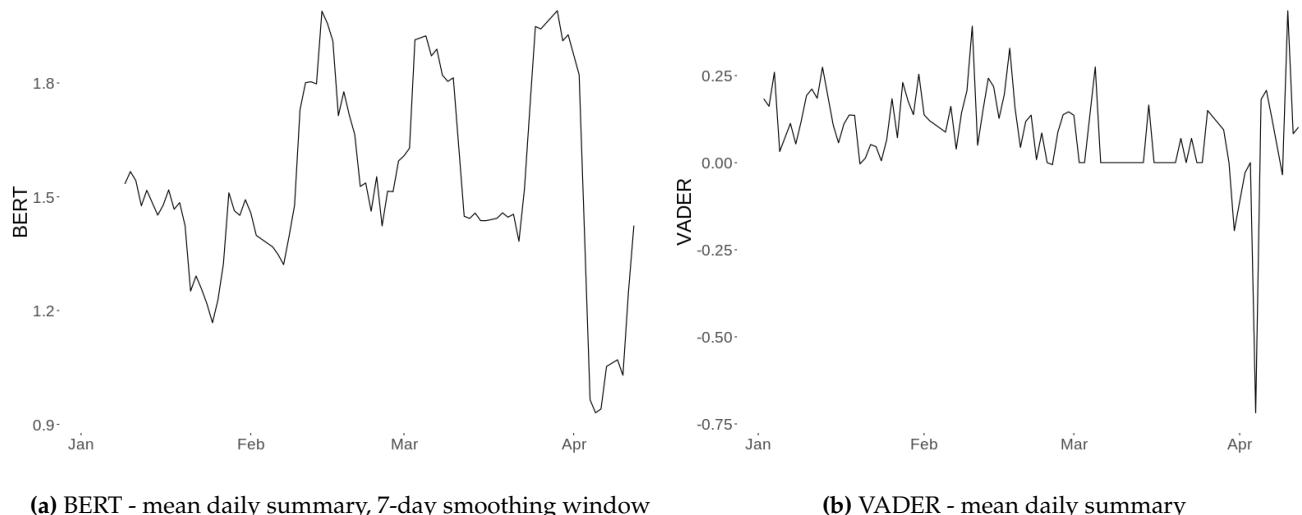


Figure 157. February 5, 2018 (mean daily summary - 7-day smoothing window)



(a) BERT - mean daily summary, 7-day smoothing window

(b) VADER - mean daily summary

Figure 158. BERT and VADER sentiment indices, constructed from with the mean daily summary. A subset of them was used in the regression to obtain the Q-Q plot of Figure 157

Table 101. Percentage of windows when BERT and/or VADER were significant (p-value <0.001) to explain the variation in the entropy sentiment index (mean daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 7 days.

Asset / Covariate	Absolute sentiment strength		Neutral sentiment		Positive sentiment	
	BERT	VADER	BERT	VADER	BERT	VADER
BTC	-	25	-	39.29	-	-
ETH	-	17.65	5.88	47.06	7.69	15.38
LTC	-	-	-	-	-	-
TRX	4.35	8.7	-	26.09	-	-
XRP	12.5	25	-	25.00	12.5	12.5

Table 102. Percentage of windows when BERT and/or VADER were significant (p-value <0.001) to explain the variation in the entropy sentiment index (mean daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 21 days.

Asset / Covariate	Absolute sentiment strength		Neutral sentiment		Positive sentiment	
	BERT	VADER	BERT	VADER	BERT	VADER
BTC	-	21.43	3.57	39.29	3.57	89.29
ETH	-	12.5	6.25	50.00	-	100
LTC	-	-	-	-	-	8.7
TRX	-	-	-	-	-	-
XRP	14.29	14.29	-	42.86	-	71.43

Table 103. Percentage of windows when BERT and/or VADER were significant (p-value <0.001) to explain the variation in the entropy sentiment index (mean daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 90 days.

Asset / Covariate	Absolute sentiment strength		Neutral sentiment		Positive sentiment	
	BERT	VADER	BERT	VADER	BERT	VADER
BTC	-	8.7	-	39.13	-	86.96
ETH	-	-	-	9.09	-	51.52
LTC	-	-	-	-	-	-
TRX	-	-	-	-	-	-
XRP	-	-	-	40	-	100

Table 104. Percentage of windows when BERT and/or VADER were significant ($p\text{-value} < 0.001$) to explain the variation in the entropy sentiment index (mean daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 180 days.

Asset / Covariate	Absolute sentiment strength		Neutral sentiment		Positive sentiment	
	BERT	VADER	BERT	VADER	BERT	VADER
BTC	-	5.88	-	29.41	-	88.24
ETH	-	-	42.86	-	-	100
LTC	-	-	-	-	-	-
TRX	-	-	-	-	-	-
XRP	-	-	-	-	-	100

Table 105. Percentage of windows when BERT and/or VADER were significant ($p\text{-value} < 0.001$) to explain the variation in the entropy sentiment index (median daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 7 days.

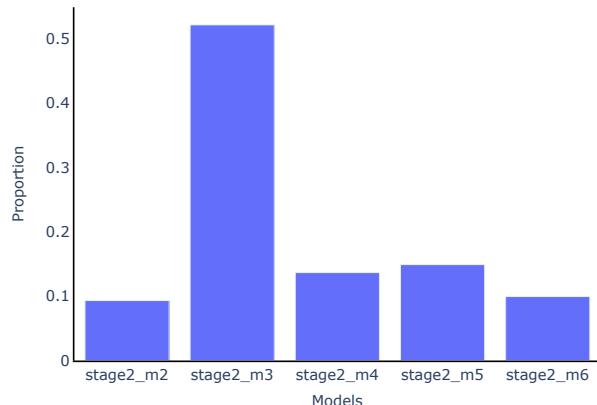
Asset / Covariate	Absolute sentiment strength		Positive sentiment	
	BERT	VADER	BERT	VADER
BTC	-	-	-	-
ETH	-	-	7.69	15.38
LTC	-	-	-	-
TRX	-	-	-	-
XRP	-	-	12.5	12.5

Table 106. Percentage of windows when BERT and/or VADER were significant ($p\text{-value} < 0.001$) to explain the variation in the entropy sentiment index (median daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 21 days.

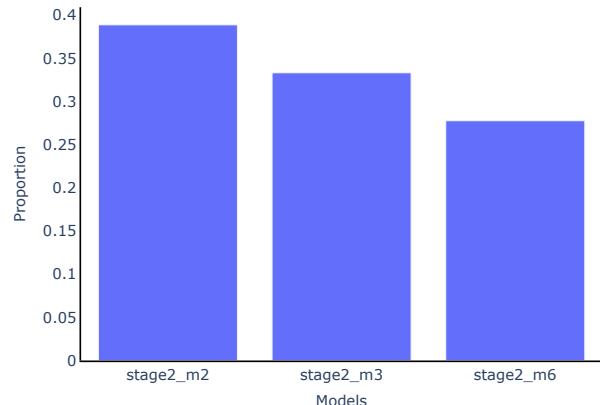
Asset / Covariate	Absolute sentiment strength		Positive sentiment	
	BERT	VADER	BERT	VADER
BTC	3.57	-	-	-
ETH	-	-	-	7.69
LTC	-	-	-	-
TRX	-	-	-	-
XRP	14.29	-	-	-

Table 107. Percentage of windows when BERT and/or VADER were significant (p -value <0.001) to explain the variation in the entropy sentiment index (median daily summary) constructed from articles about the corresponding asset, from both Cryptodaily and Cryptoslate. The smoothing window used for the BERT covariate was 90 days.

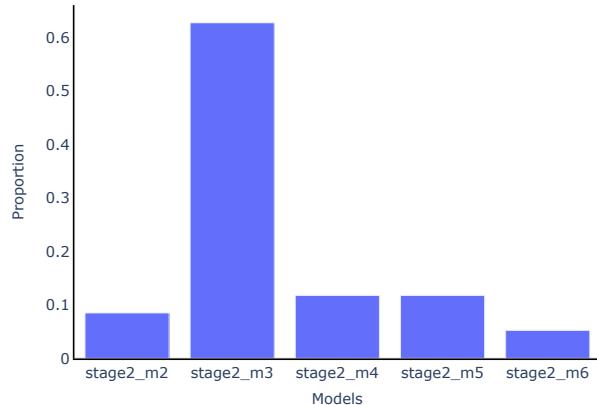
Asset / Covariate	Absolute sentiment strength		Positive sentiment	
	BERT	VADER	BERT	VADER
BTC	-	-	-	-
ETH	-	-	-	6.06
LTC	-	-	-	-
TRX	-	-	-	-
XRP	-	-	-	-



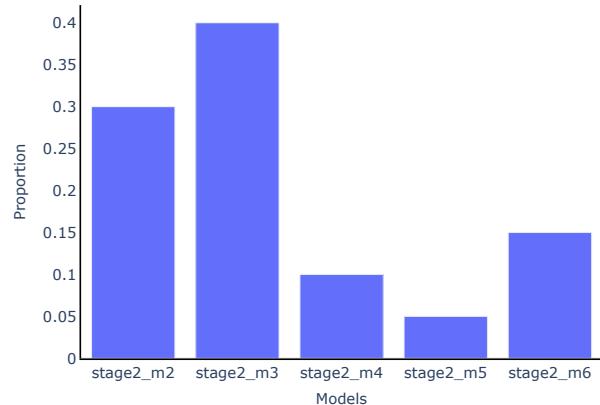
(a) Mean daily summary - 7-day smoothing window



(b) Median daily summary - 7-day smoothing window



(c) Mean daily summary - 21-day smoothing window



(d) Median daily summary - 21-day smoothing window

Figure 159. Proportion of successfully fitted models for the windowed distributed lag regression

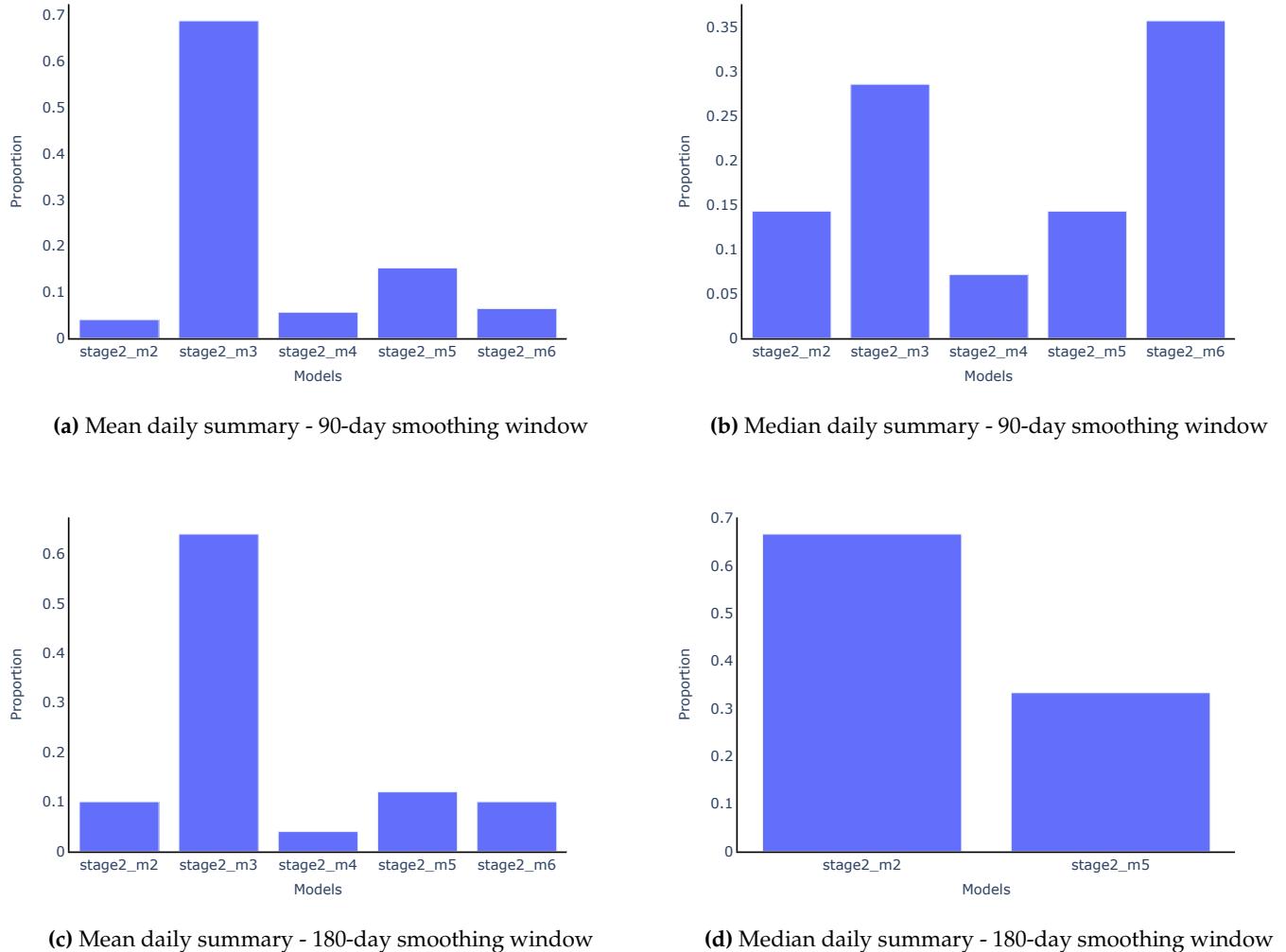


Figure 160. Proportion of successfully fitted models for the windowed distributed lag regression

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