Crypto Analysis: What a Cluster

Aquiba Benarroch
Dariush Ruch-Kamgar
Tim Moriarty
David Dannenberg

Objectives

1- Utilize unsupervised learning algos to identify relationships between different cryptocurrencies based on the daily movement of their market capitalization

2- Identify relationships between news headlines and changes in cryptocurrency market capitalization utilizing unsupervised learning and sentiment analysis.

(Note, we focus on daily changes in market capitalization and not price to normalize for the varying rates of supply emissions between cryptos)

Data Sources

Chose CoinGecko API due to the breadth of tokens available.

- Data availability forced us to limit data lookback to one year
- Rejected CoinMetrics API due to limited data breadth.

Manual collection and sensitivity assessment of relevant news articles

- Subject matters: China, institutional adoption, and regulation.

Objective #1

Identify relationships between tokens based on valuation

Data Collection and Preprocessing

Retrieved “ids” for the Top 500 cryptocurrencies by market capitalization.

- API limit of 250 results per page.

Retrieved the market capitalization data for selected tokens

- Limit of 50 calls per minute - created a workaround to avoid the rate limit
- Pulled daily data for all 500
- When cleansing the data for NaN values this fell to 220
- Many tokens were obscure/niche/lacked trading volume
- Ultimately selected 52 tokens across various categories: L1/L2 Chains, DEXs, Play-to-earn, Meme, and middleware

Calculated daily pct_change as final DataFrame for clustering analysis

At a Glance

52 cryptocurrencies

64 news articles

1-year lookback period

CoinGecko API

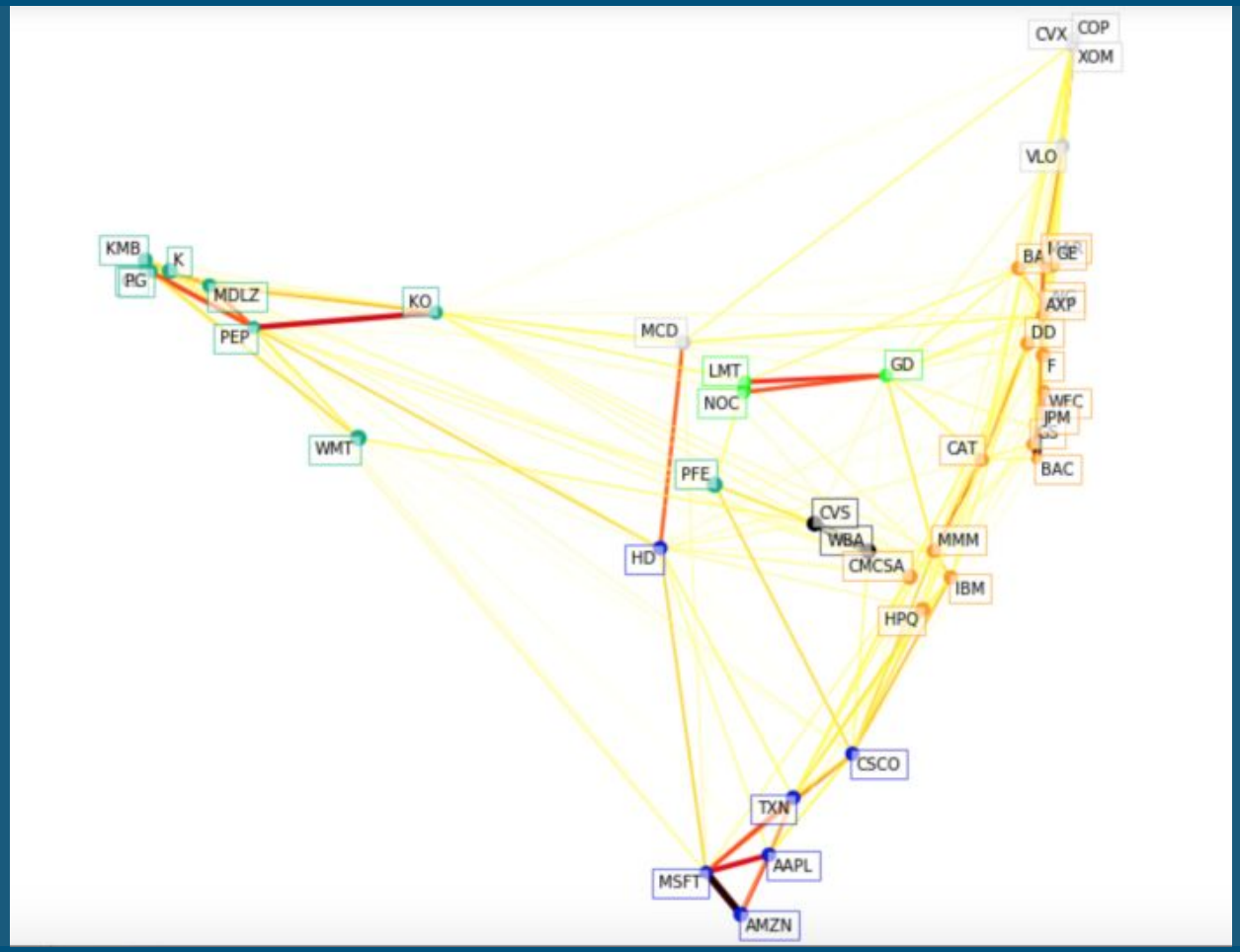
Market Capitalization analysis

- Affinity Propagation (clustering)
- Graphical Lasso (partial correlation)
- Locally Linear Embeddings (visualization)

News analysis

- KMeans

Clustering Analysis Inspiration



- MSFT, AAPL, AMZN, TXN all have same color nodes, bold lines connecting, and positioned closely together
- Indicates a close relationship based on variations in historical stock prices
- Potential pairs trading opportunity
- Diversified portfolio creation

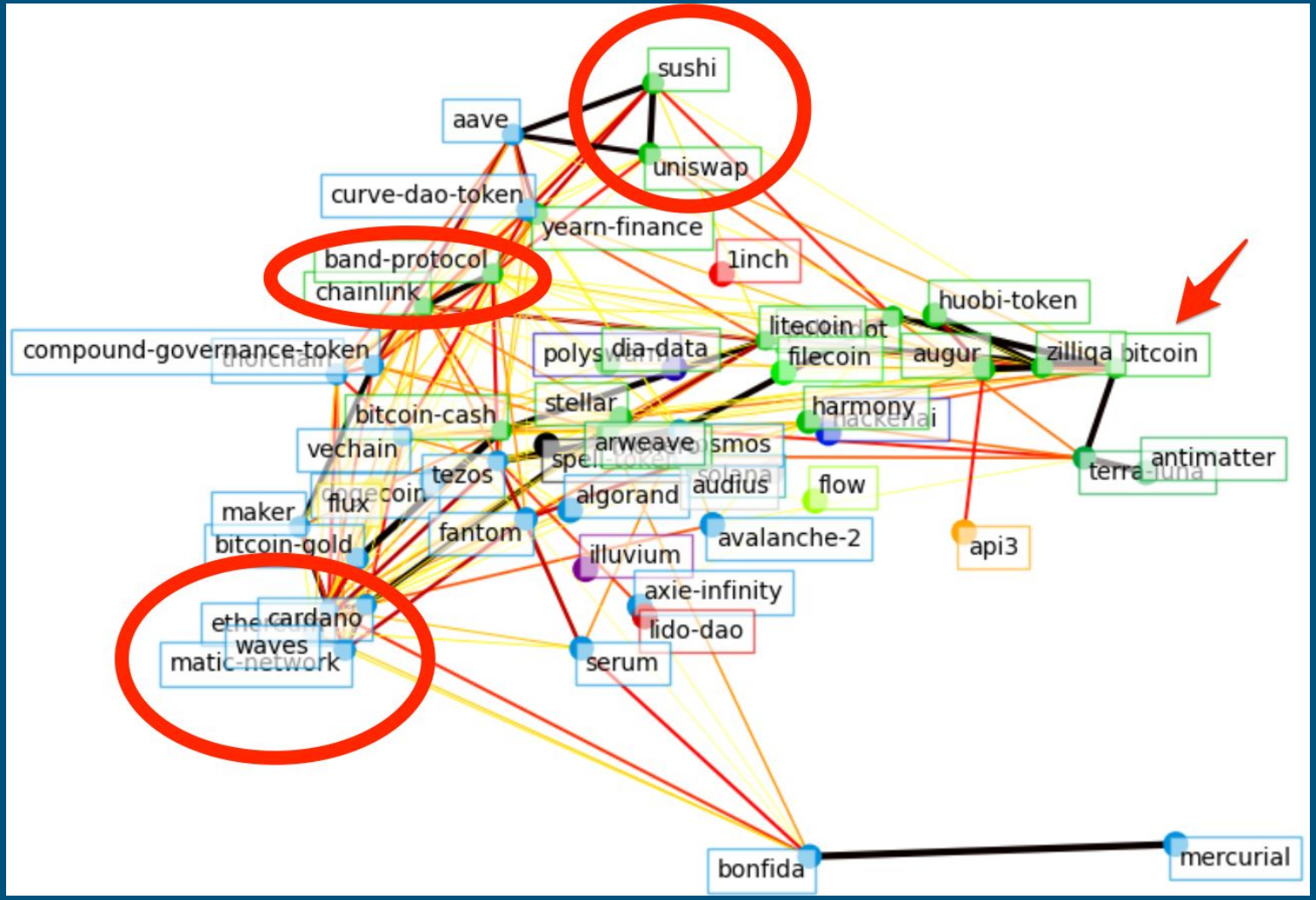
Three-Model Clustering Approach

Graphical Lasso (lines between the nodes) is a sparse inverse covariance estimate to determine the partial correlation between variables and control for the impact of confounding variables in typical correlation calculations

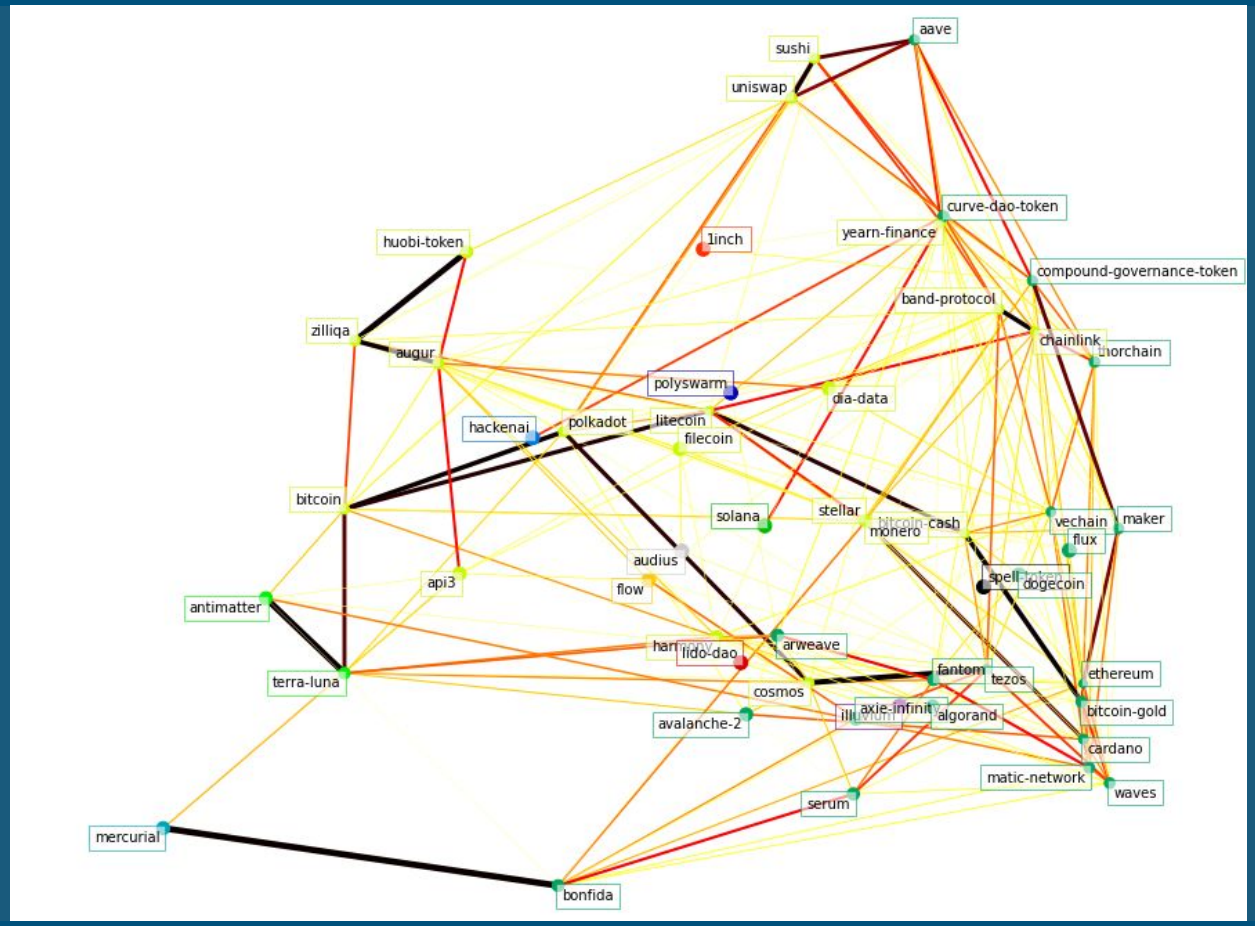
Affinity Propagation (color of the nodes) is a clustering analysis similar to KMeans with the advantage of self-optimizing the number of clusters

Manifold learning - Locally Linear Embedding (closeness of the nodes) is similar to a nonlinear PCA analysis, allowing 2D visualization

Model Output: Tokens clustered across all three models have strongest relationship



Model Output – Price Action Clustering

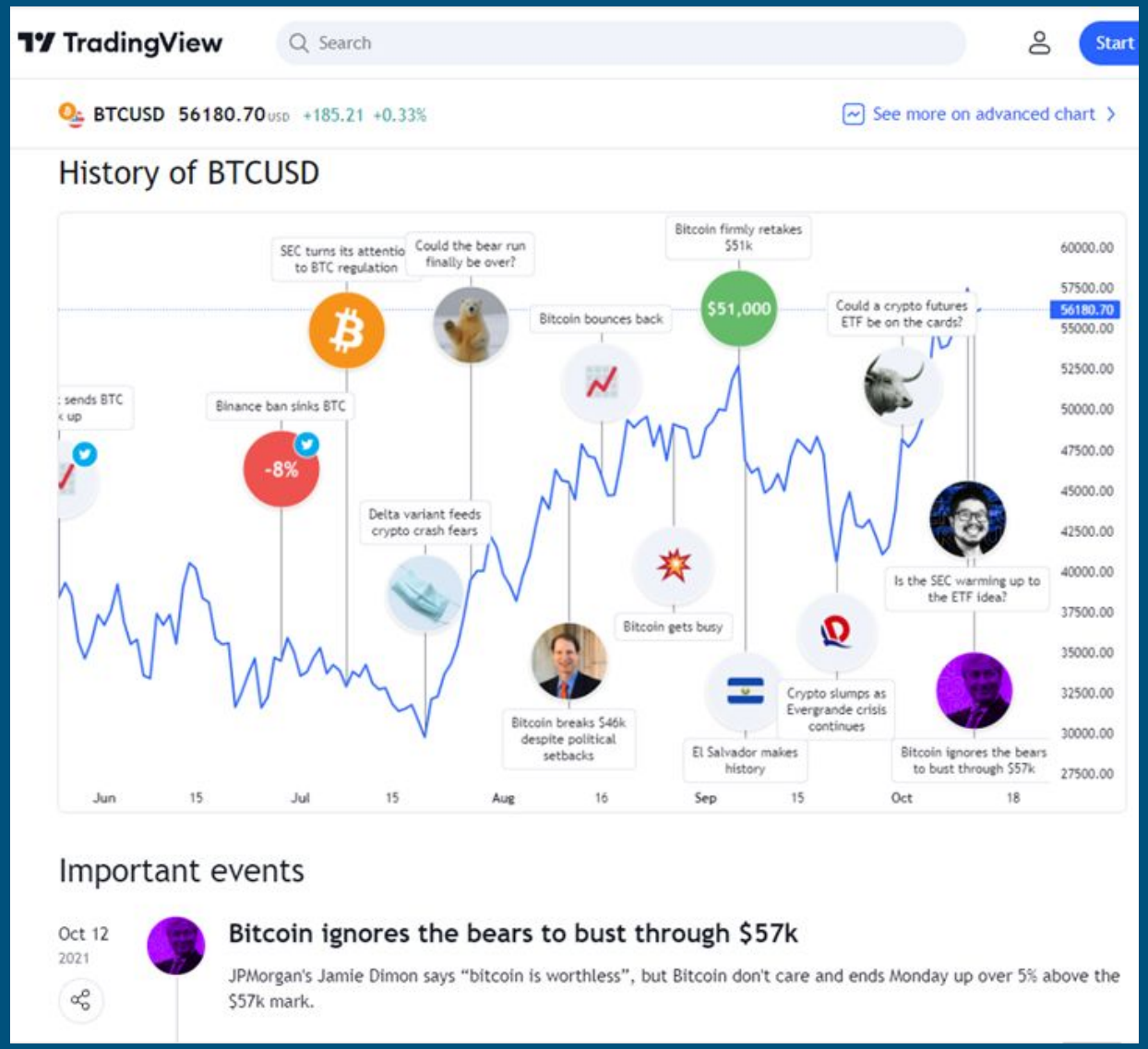


- 3 model cluster:
  - Strength of lines - Lasso Cross-Validation (sparse inverse covariance estimation)
  - Color of nodes - Affinity Propagation (clustering that doesn't enforce equal size clusters andcan automatically determine the number of clusters - analogous to k-means)
  - Positioning of nodes - Manifold learning
- Insights:
  - Tokens clustered across all three models have strongest relationship: yearn and curve, sushi and uniswap, Chainlink and Band etc
  - Smart contract platforms were well clustered and distinct from BTC

Objective #2

Identify relationships between tokens using crypto news

Data Collection - Crypto News Sources



Data Collection - Crypto News Assessment

2021 CRYPTO NEWS				
DATE	**NEWS**	**NEWS CATEGORY**	**COIN**	**SENTIMENT**
1/5/2021	JP Morgan: BTC Could Hit $146K	Banking	BTC	1
1/11/2021	UK FCA Warns: Prepare to Lose All Your Money	Government	CRYPTO	-1
1/14/2021	Bitcoin Core Major Upgrade (0.21.0)	Infrastructure	BTC	1
1/25/2021	UK FCA Warns: Bitcoin's Days Are Numbered	Government	BTC	-1
1/28/2021	Musk Positive BTC Tweet	Musk Tweet	BTC	1
1/28/2021	Musk Positive DOGE Tweet	Musk Tweet	DOGE	1
1/28/2021	Dorsey Positive BTC Tweet	Dorsey Tweet	BTC	1
2/5/2021	Elon Musk Tweet: Dogecoin to the Moooonn	Musk Tweet	DOGE	1
2/8/2021	SEC Filing: Tesla Bought $1.5 Billion in BTC	Government	BTC	1
2/8/2021	Tesla Accepts BTC as Payment	Corporate	BTC	1
2/10/2021	Mastercard: Bringing Crypto onto its Network	Corporate	CRYPTO	1

Data Preprocessing and Approach

Defined a new dataframe with the dates when news signals happened.

- Data is daily change in market capitalization for the same 52 tokens.
- Included 64 dates with news events

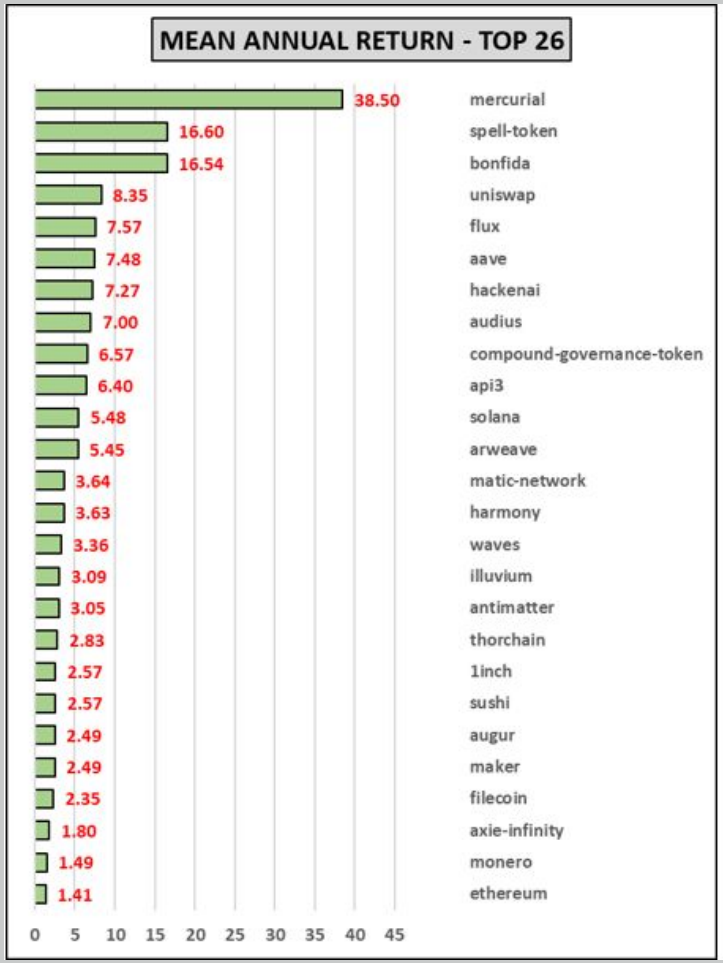
Calculated annual returns and variances for the selected dates.

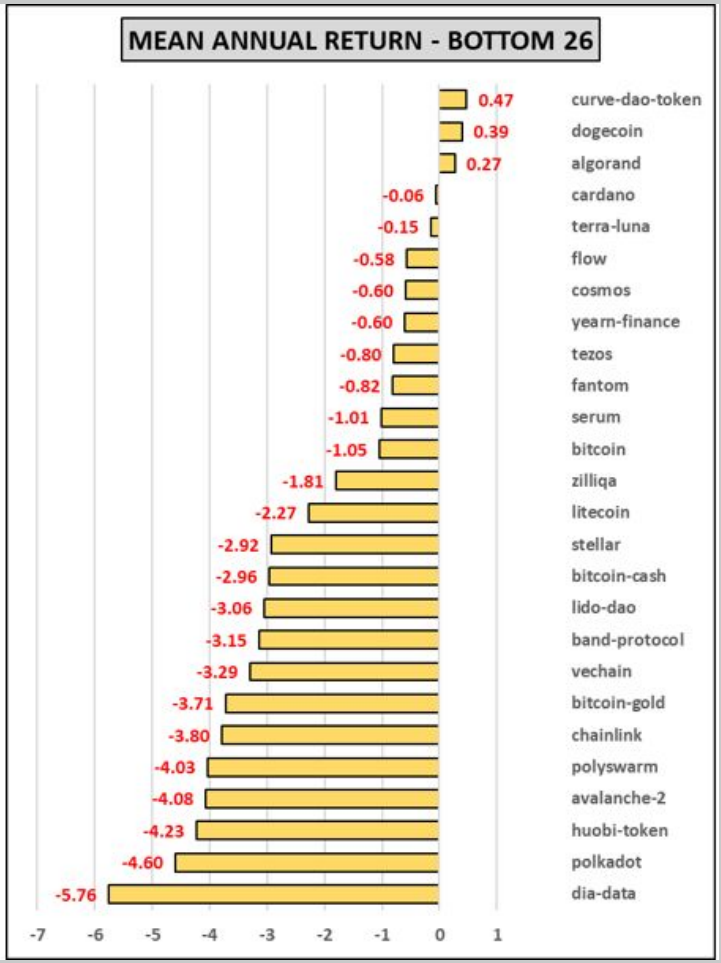
Used the KMeans algorithm for clustering.

Crypto price movements on days with a major crypto-related headline appear well-clustered

Annual Return on News Days

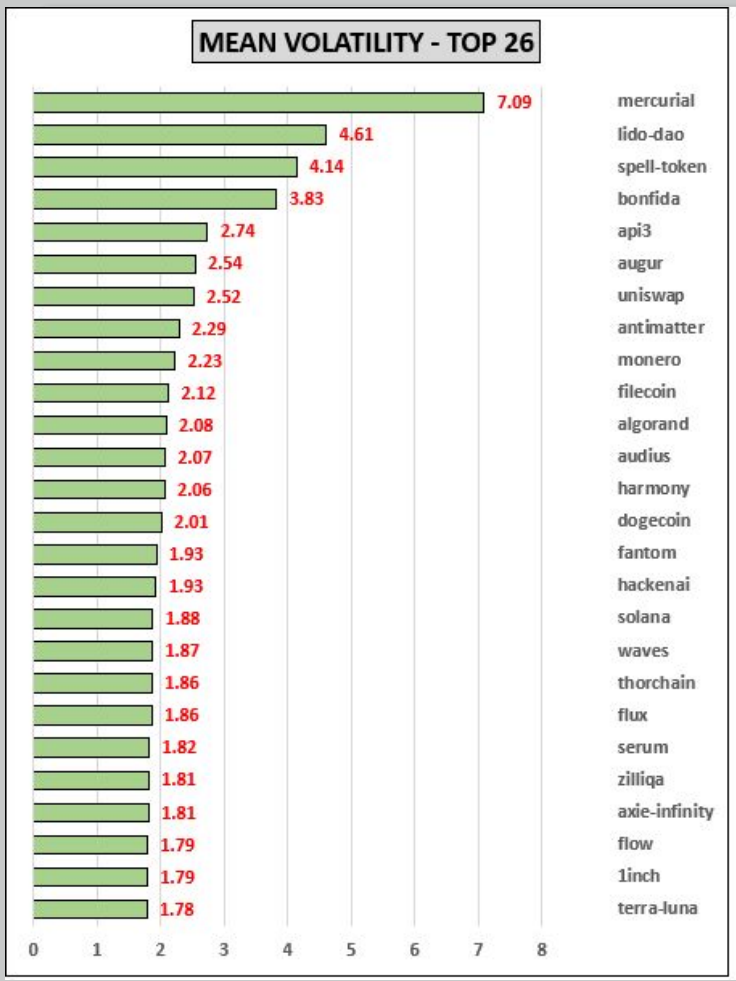
On days with news, tokens on the left outperformed tokens on the right

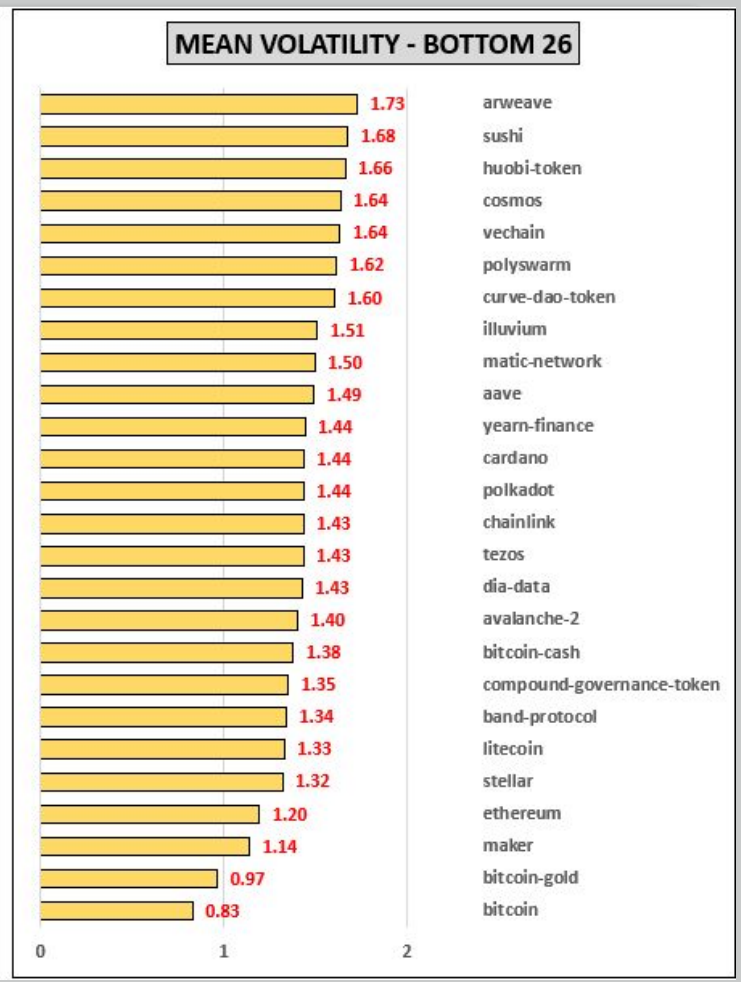




Volatility on News Days

On days with news, tokens on the left were more volatile than tokens on the right



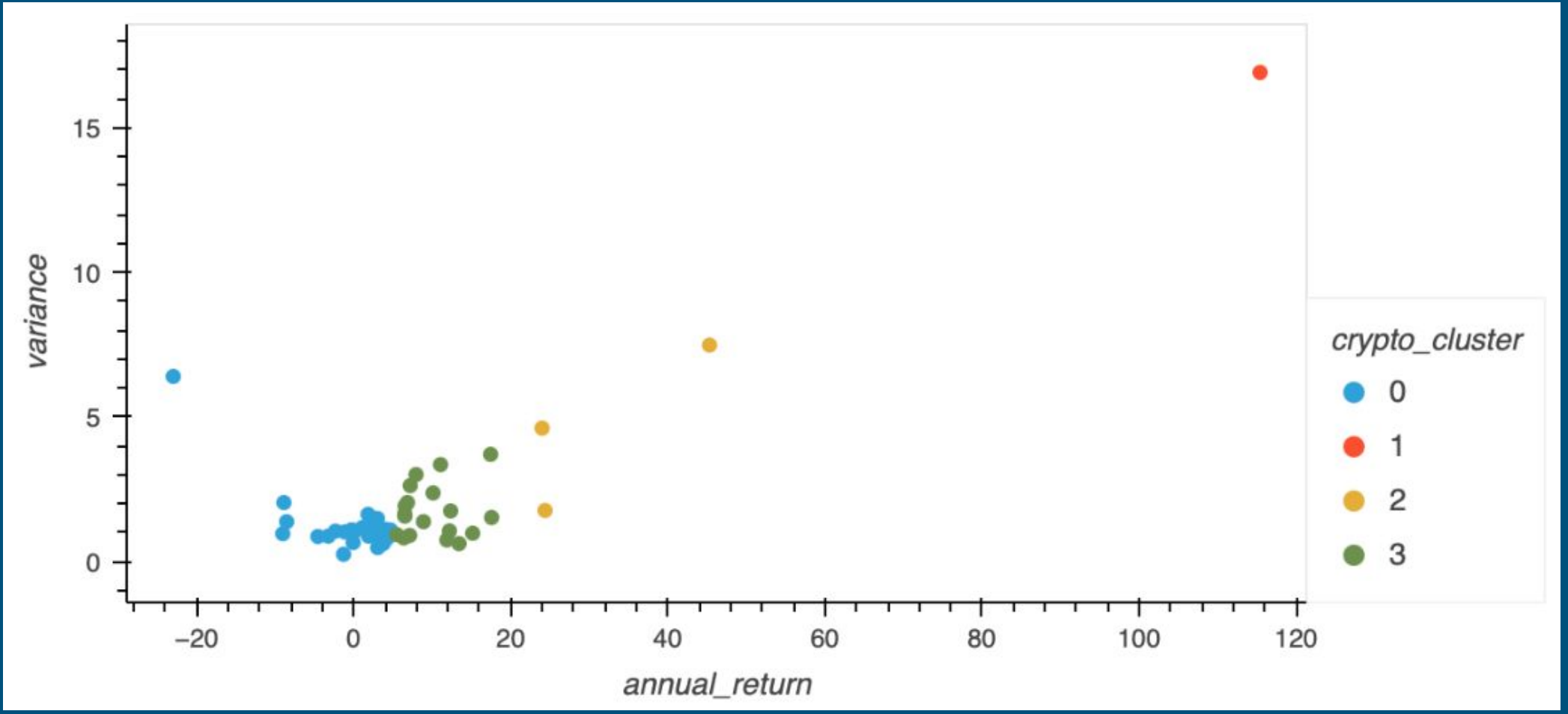


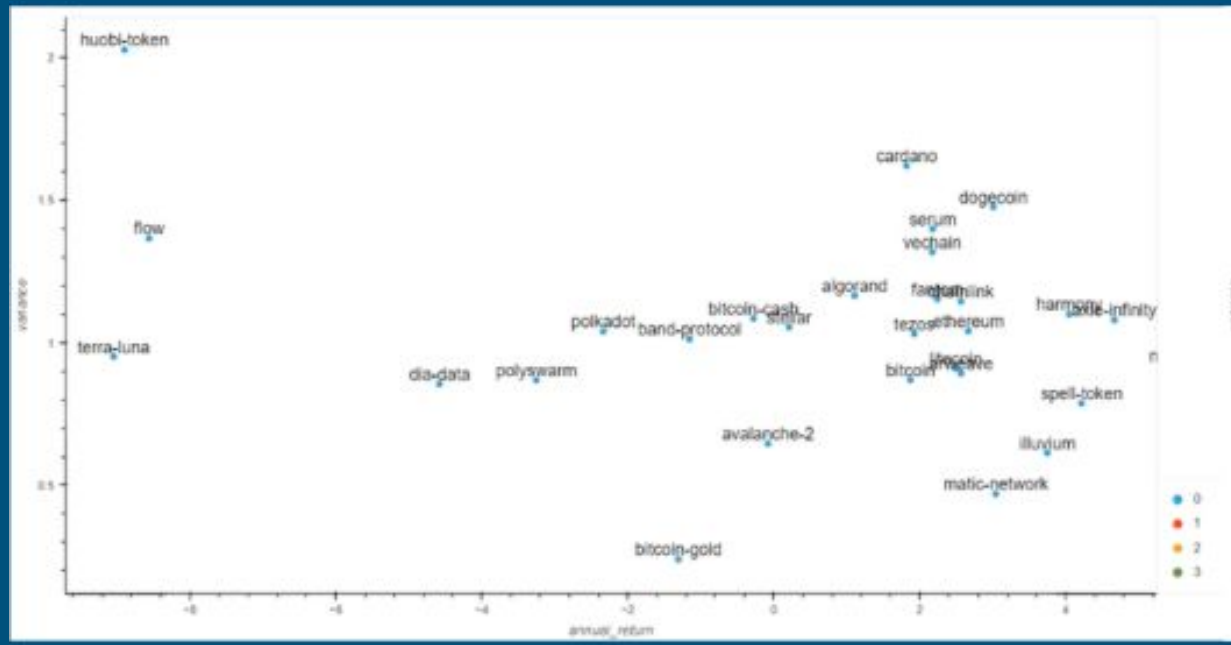
CHINA NEWS - 2021

DATE	NEWS	CATEGORY	INDICATOR
5/18/2021	China Bans Institutions From Crypto Business	China	-1
5/21/2021	China Crackdown on Mining & Trading	China	-1
6/21/2021	China Intensifies Mining Crackdown	China	-1
9/20/2021	Evergrande Crisis Hits	China	-1
9/27/2021	China: All Crypto Business is Illegal	China	-1

China News

Decentralized applications (DEX) meaningfully outperformed other tokens

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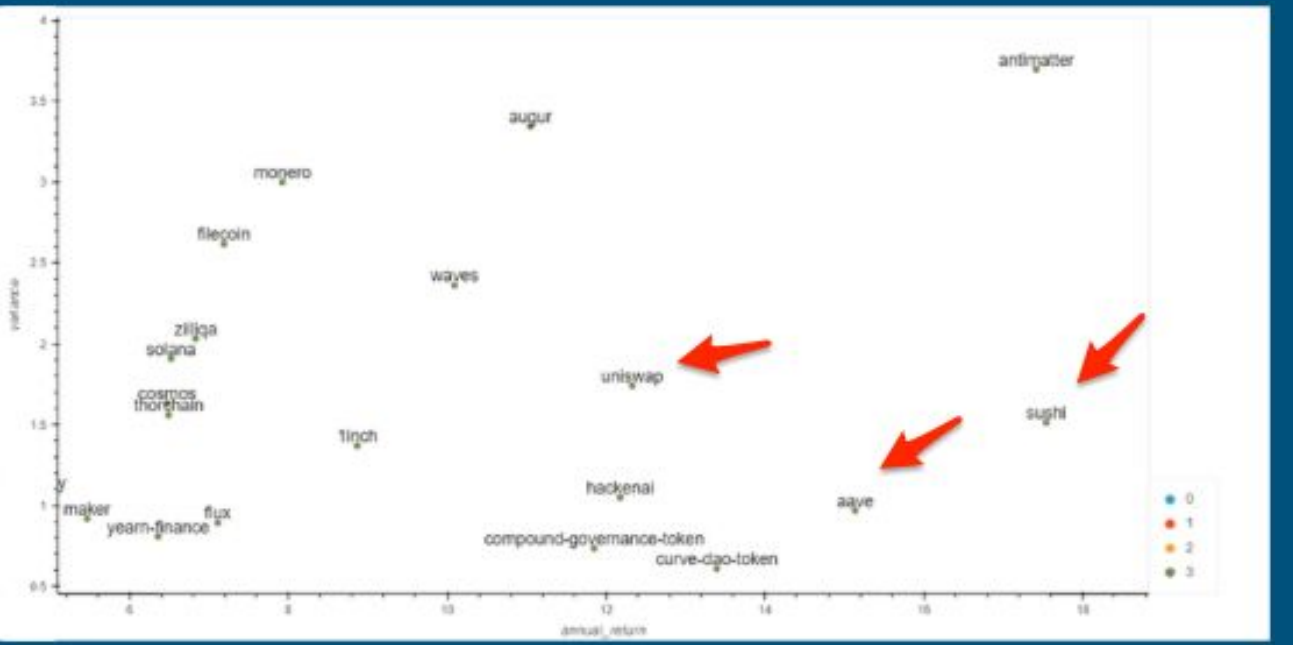
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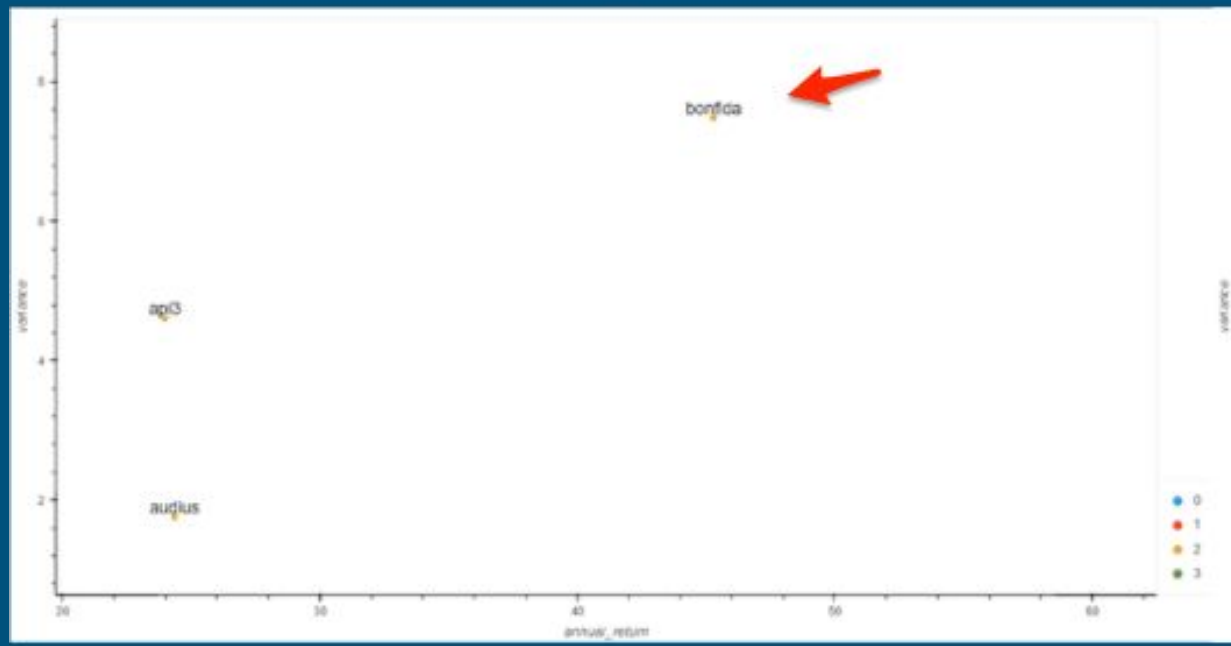
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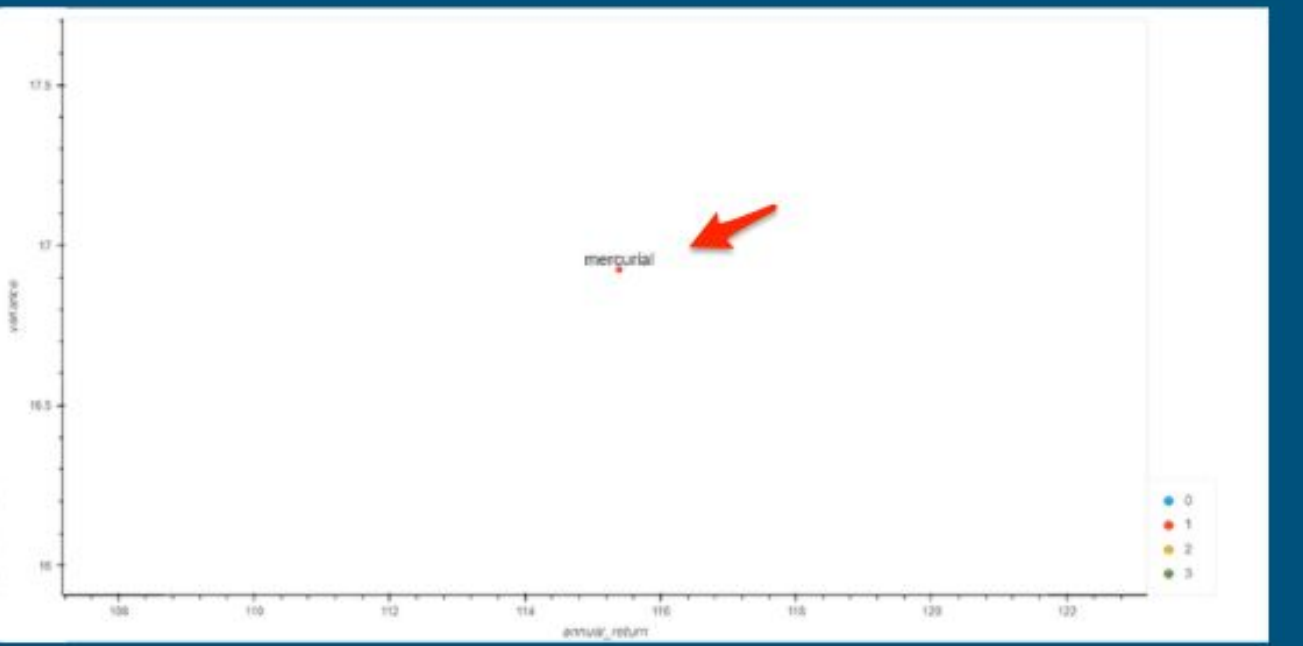
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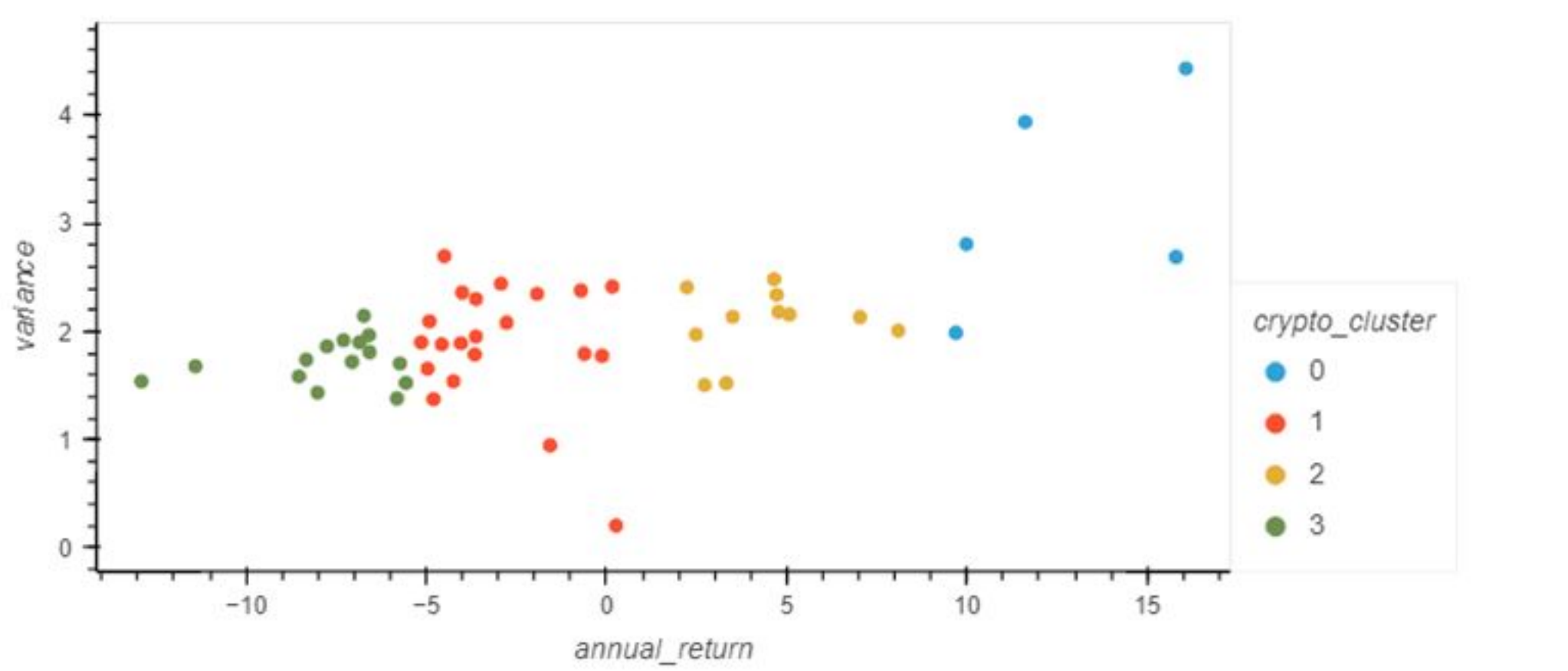
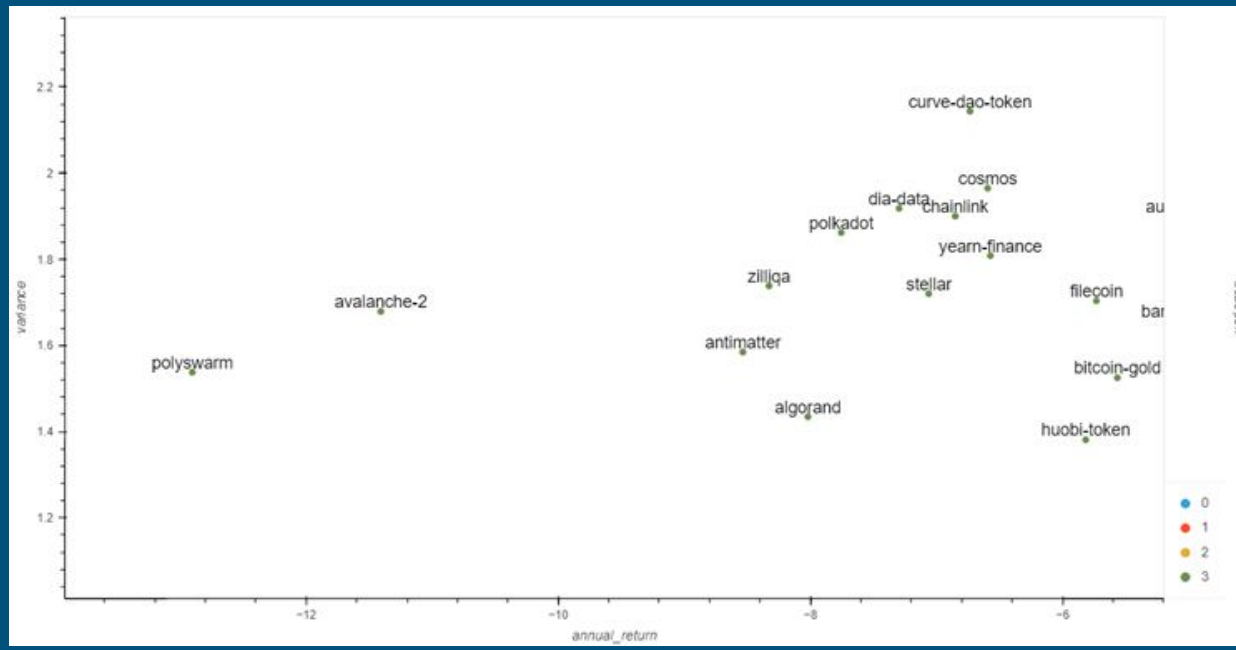
Regulatory News (EU and USA)

Greater dispersion of returns and volatility may indicate surprise news

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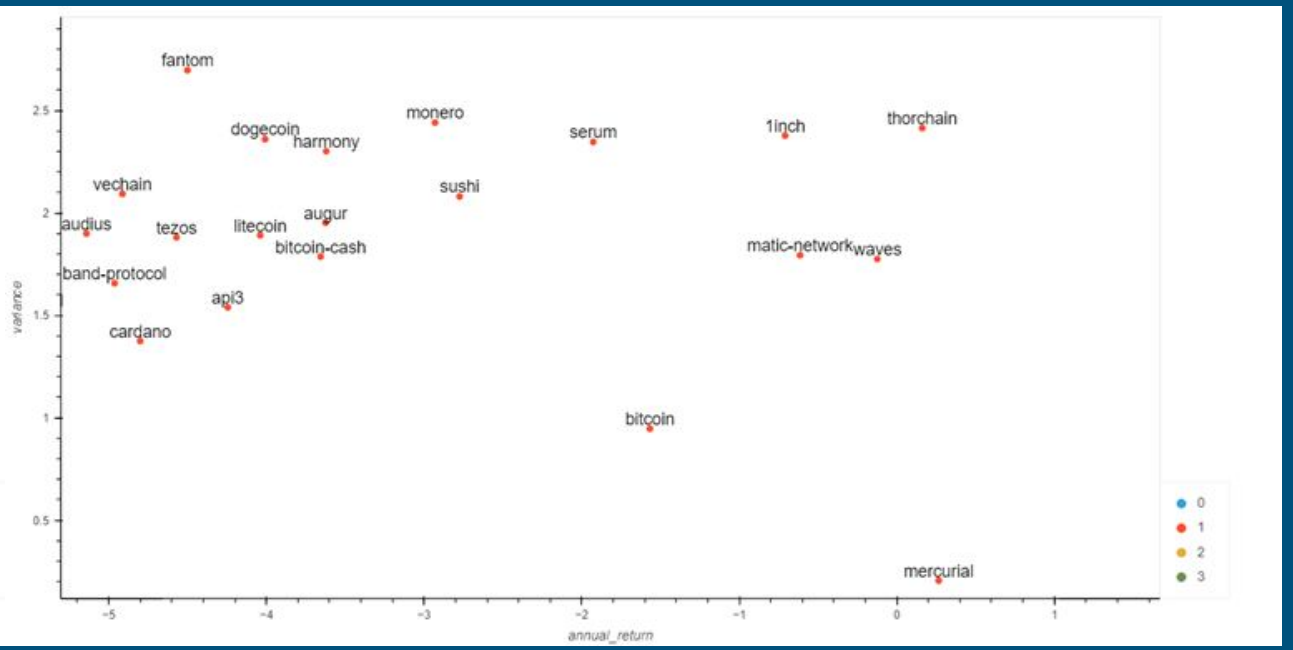
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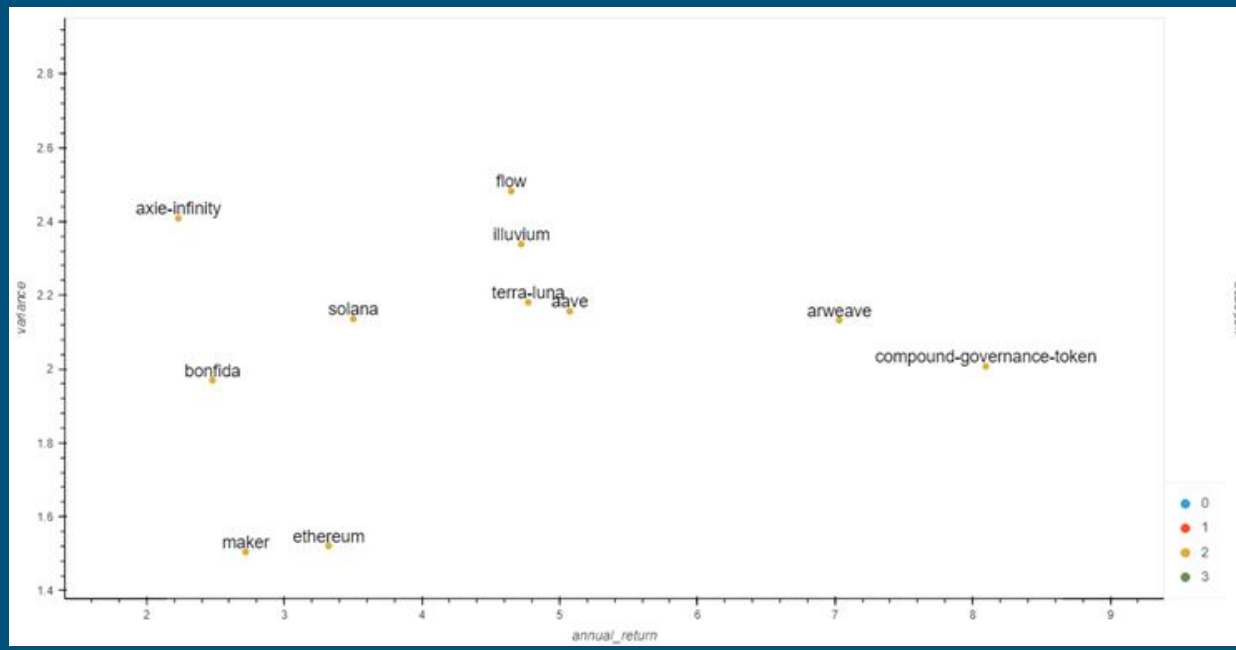
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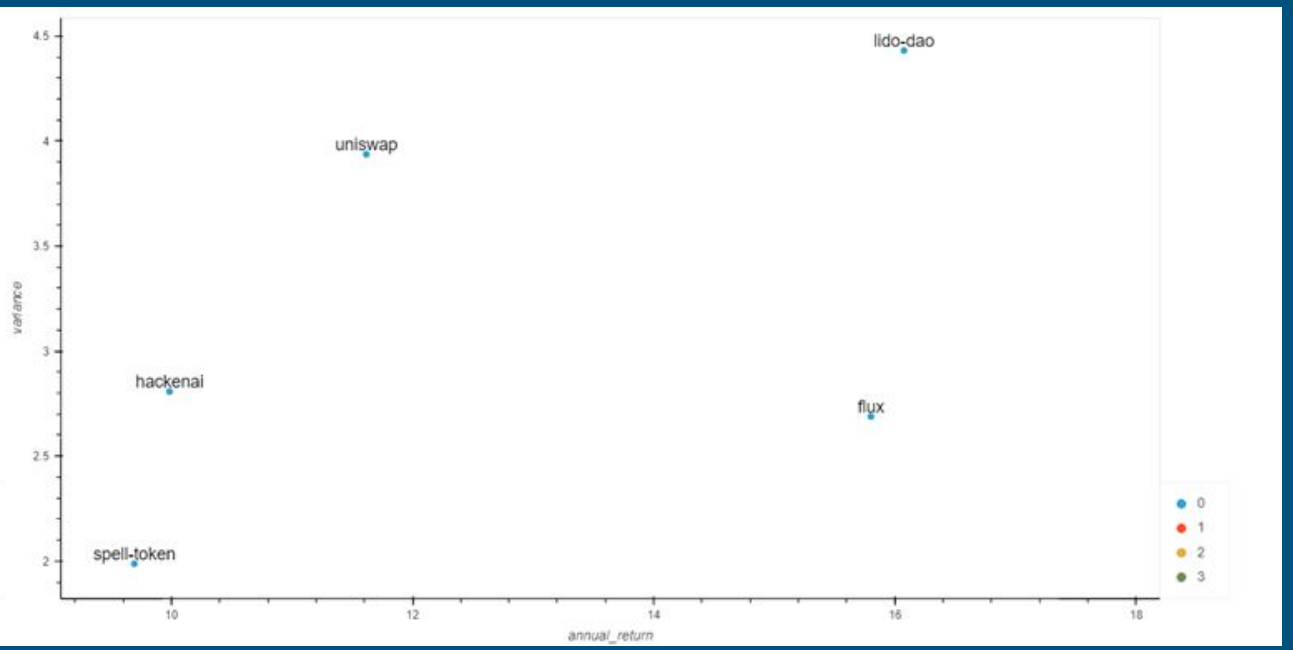
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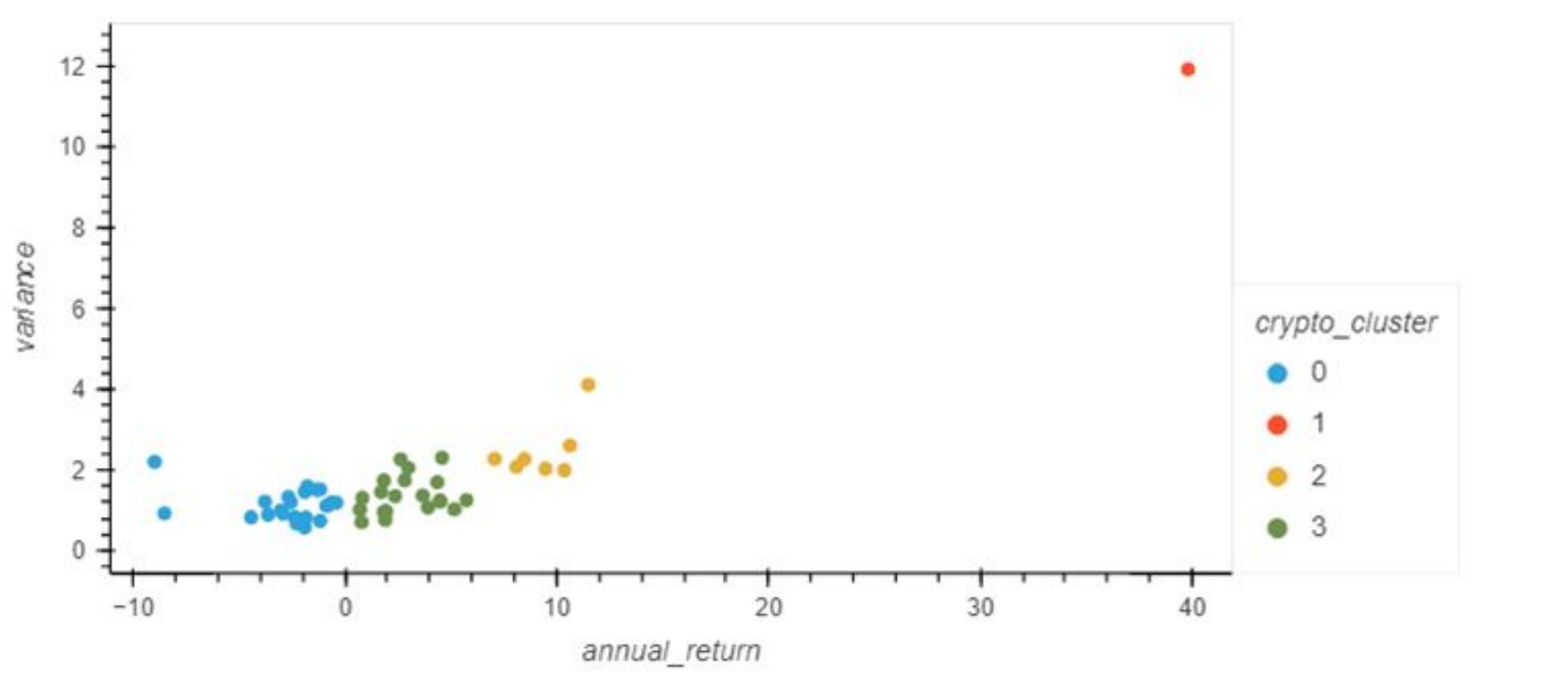
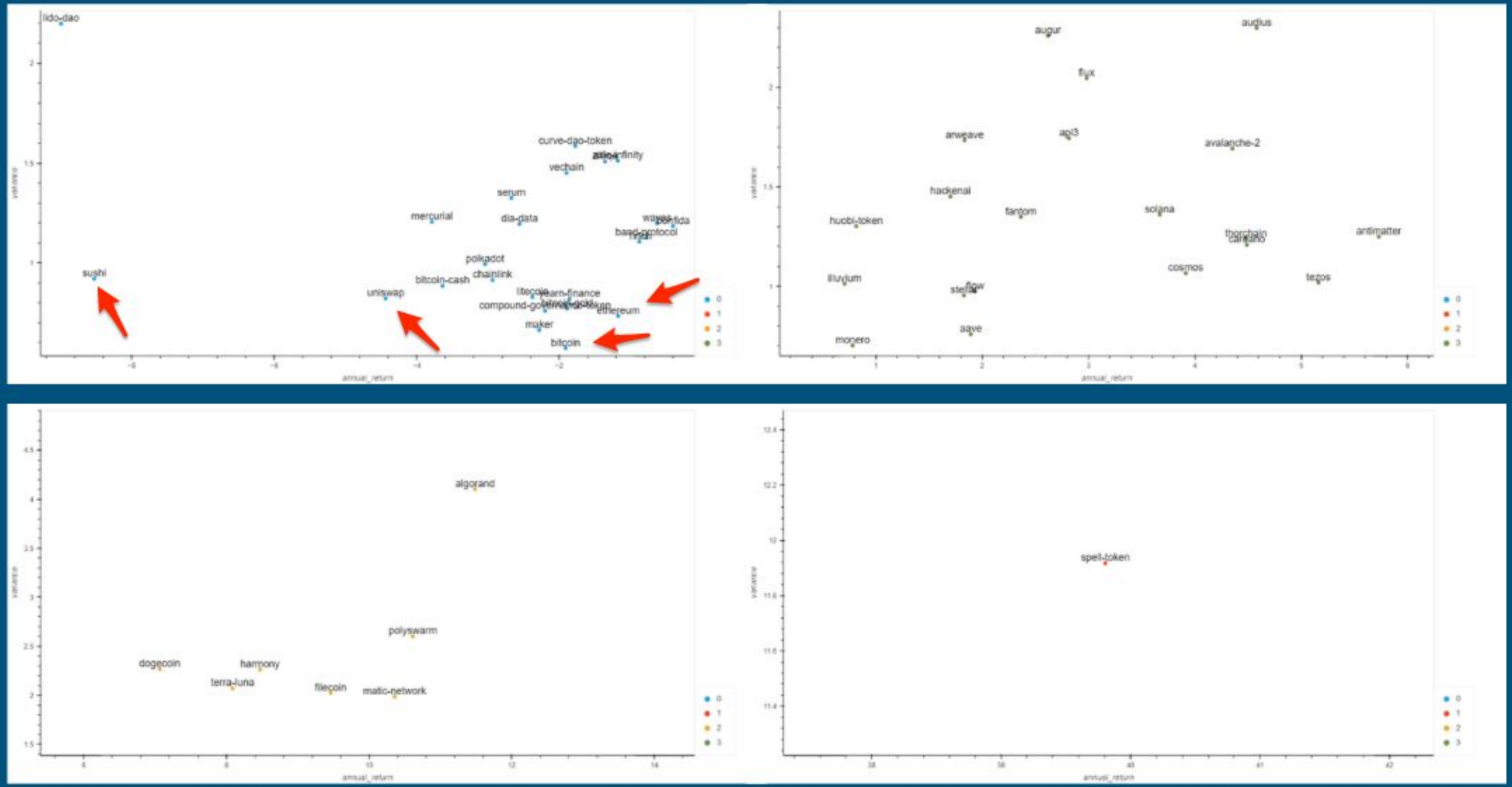
Positive Institutional News

Large cap tokens (ETH, BTC, UNI, SUSHI) reacted negatively to the news.

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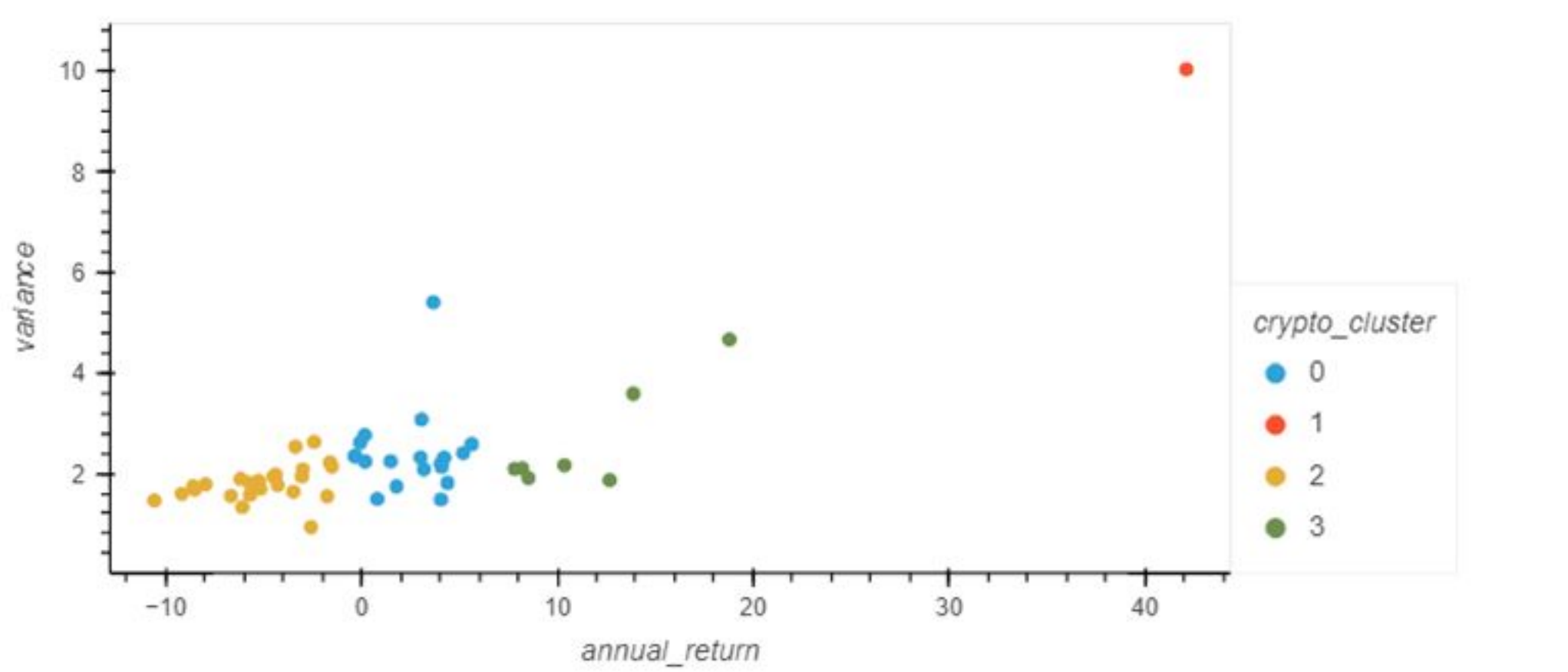
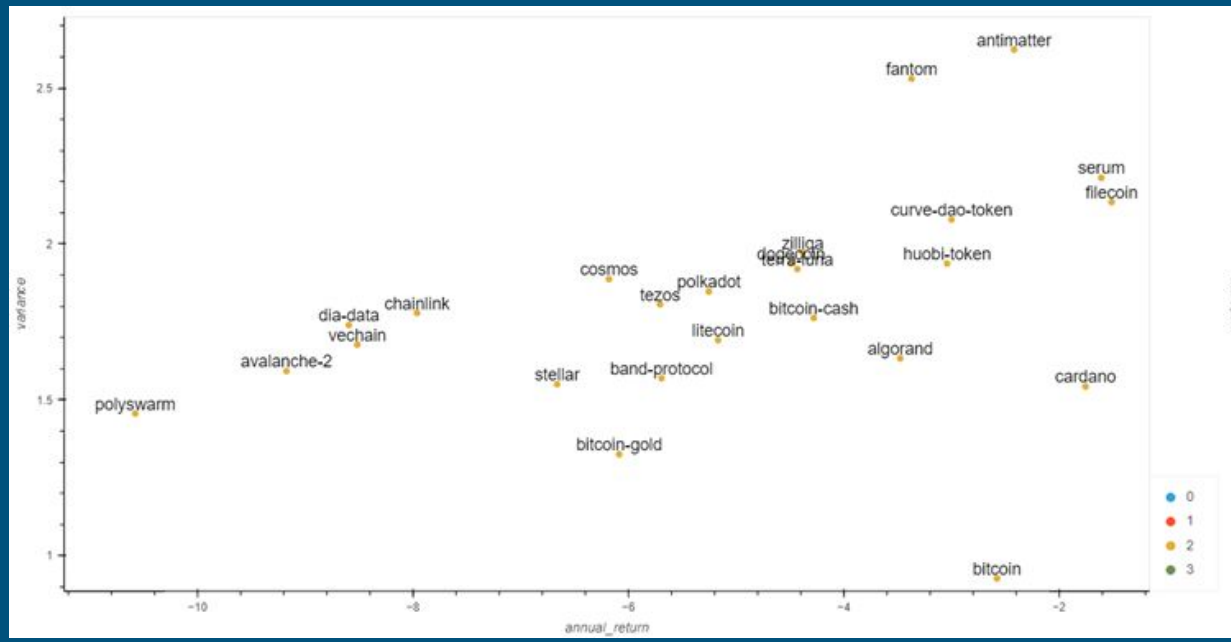
Negative Institutional News

Greater dispersion of returns and volatility compared to positive news

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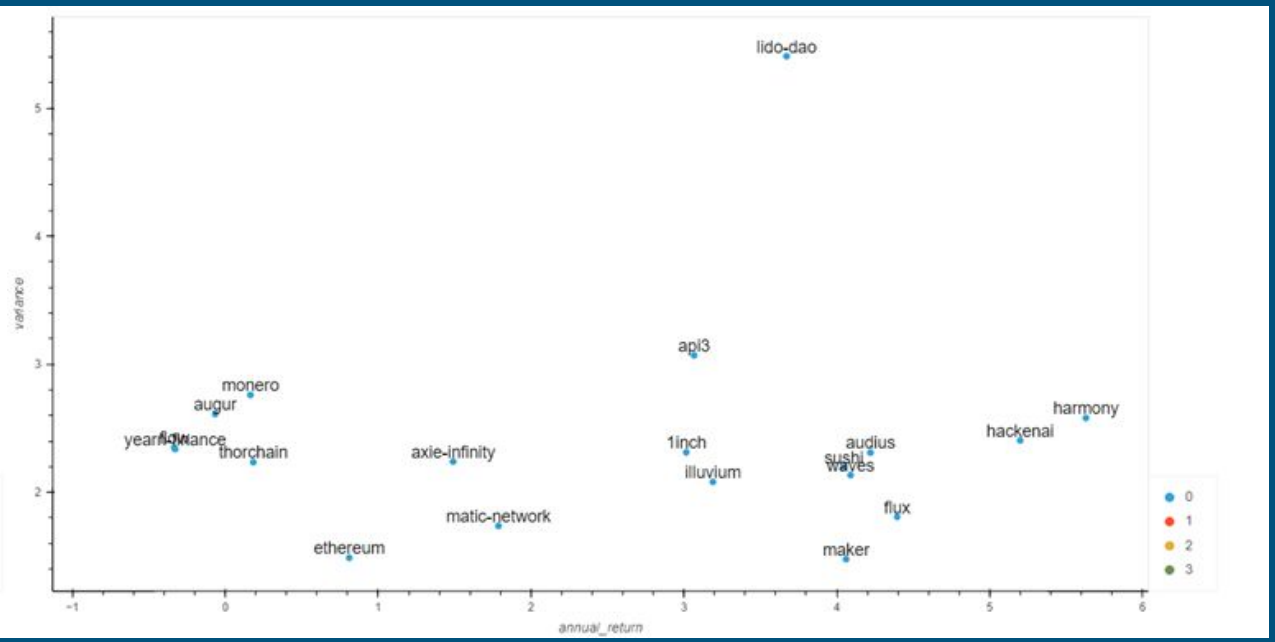
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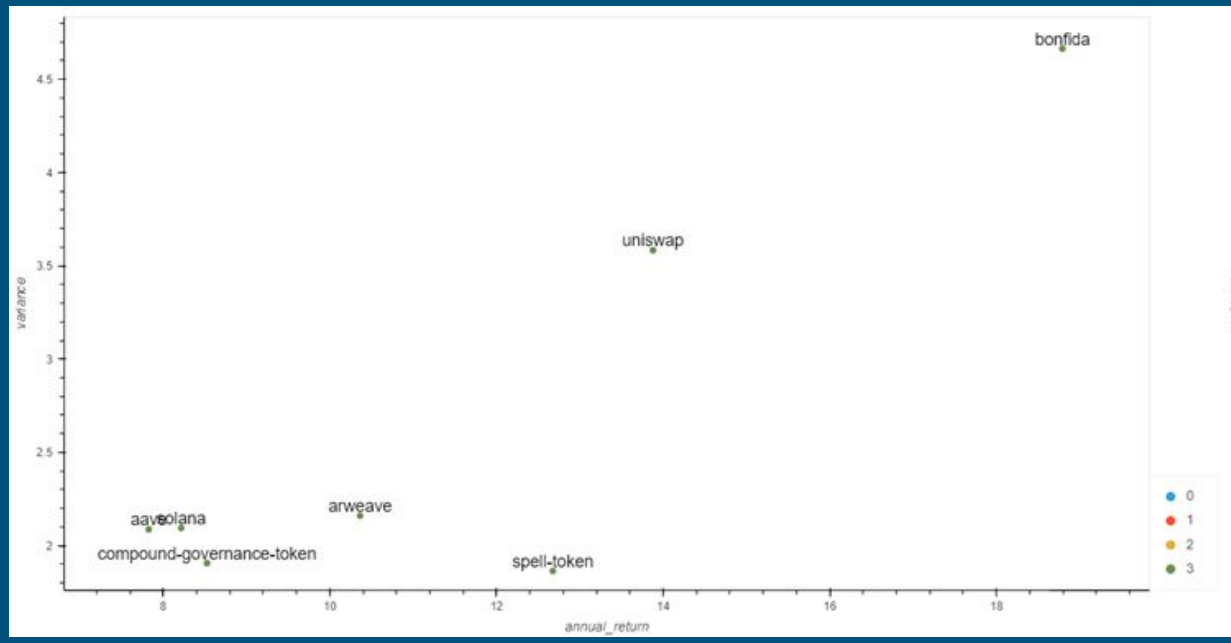
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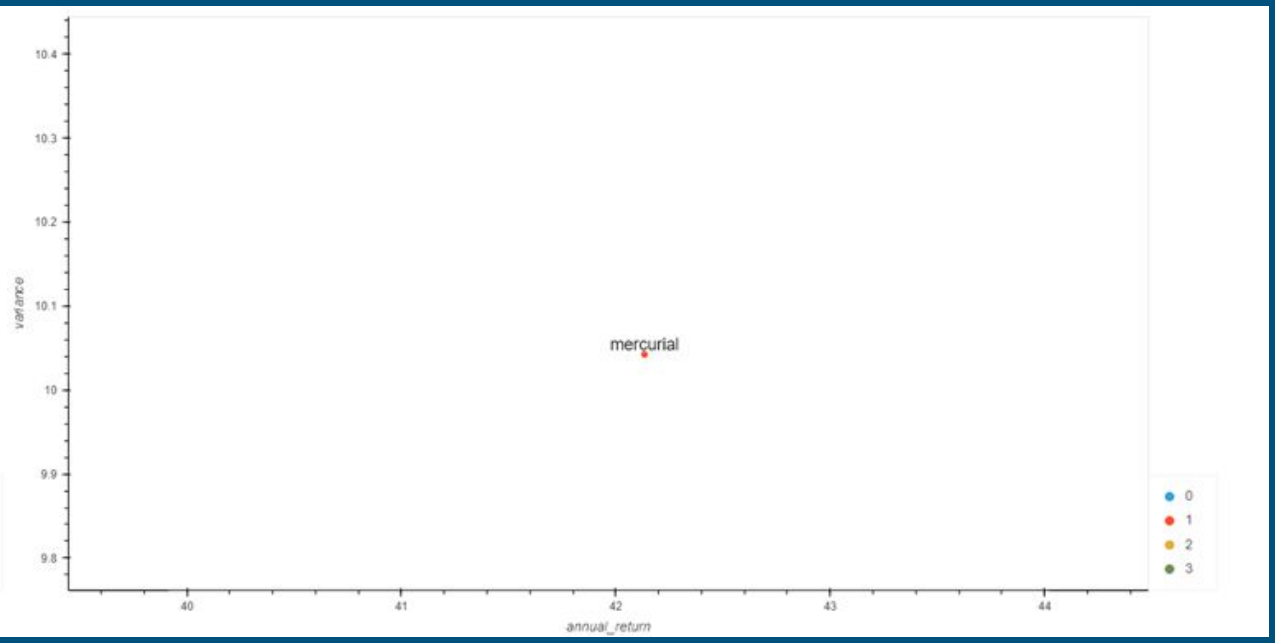
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Key Insights

- Crypto price movements on days with a major crypto-related headline were well-clustered
- On days where China bans made headlines, decentralized exchanges meaningfully outperformed
- On days when European and American regulatory headlines were negative, decentralized exchanges and yield management platforms slightly outperformed
- Among cryptocurrencies, we found smart-contract names to be well clustered and payments names to be well-clustered according to price action

Opportunities for Future Work

1) Cluster model - could add to data set or adjust model methodology
   a) Different methods could be used to confirm model output (e.g. different manifold learning instead of locally linear embedding, etc)
   b) Could combine equities to determine relationship between equity and crypto price action
   c) Could formally categorize cryptocurrencies and incorporate into model to determine relationships across different types (e.g. DEX vs. yield)

2) News analysis - could code the news with additional metrics or coded additional stories and observe model changes
   a) Compare price behavior on news events to dates without news events
   b) Compare impact of news events over time