The FCO Cockpit
Global Bubble Status Report

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About

The Financial Crisis Observatory (FCO) monthly report discusses the historical evolution of bubbles in and between different asset classes and geographies.

It is the result of an extensive analysis done on the historical time series of about 450 systemic assets and about 850 single stocks. The systemic assets are bond, equity and commodity indices, as well as a selection of currency pairs. The single stocks are mainly US and European equities. The data is from Thomson Reuters.

In the first part of this report, we present the state of the world, based on the analysis of the systemic assets. In the second part, we zoom in on the bubble behavior of single stocks and discuss some specific cases.

To new readers, we recommend proceeding to the appendix for more detailed information about the methodology and procedures applied in this report.

For an intuitive explanation of the methodology and the specifics of the indicators that are used in this report, we refer to: D. Sornette and P. Cauwels, Financial bubbles: mechanisms and diagnostics. Review of Behavioral Economics 2 (3), 279- 305 (2015)
http://arxiv.org/abs/1404.2140 and http://ssrn.com/abstract=2423790
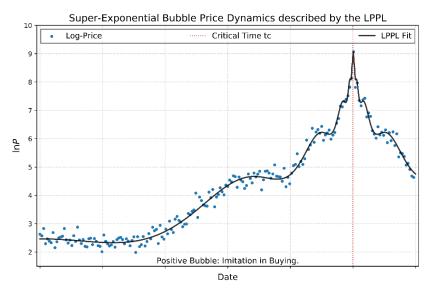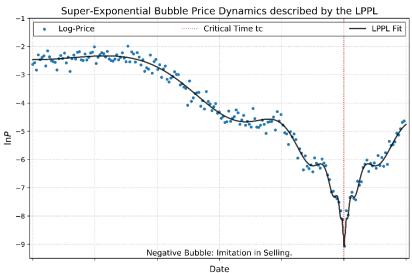
Methodology

We use the Log-Periodic Power Law Singularity (LPPLS) model to hunt for the distinct fingerprint of Financial Bubbles. Basic assumptions of the model are:

1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.

2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in volatility towards the end of the bubble.

3. At the end of the bubble, the so-called critical time t_c, a finite time singularity occurs after which the bubble bursts.
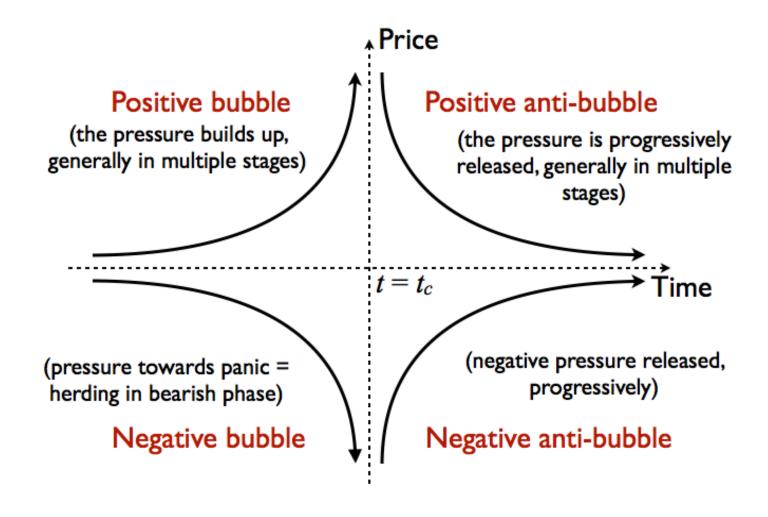
Together, these effects encompass irrational imitation and herding phenomena amongst market participants that lead to blow-up and instability of asset prices.

Super-Exponential Bubble Price Dynamics described by the LPPL
Positive Bubble: Imitation in Buying.

Super-Exponential Bubble Price Dynamics described by the LPPL
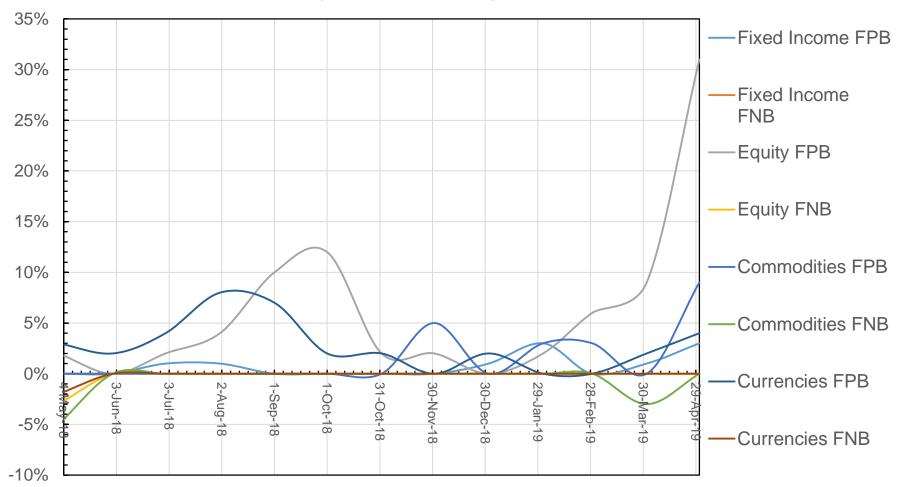Negative Bubble: Imitation in Selling.

Bubble Regimes

General Results – The Big Picture

Historical evolution of the fraction of assets within an asset class that show significant bubble signals

Legend:
- Fixed Income FPB
- Fixed Income FNB
- Equity FPB
- Equity FNB
- Commodities FPB
- Commodities FNB
- Currencies FPB
- Currencies FNB

FPB – Fraction of Positive Bubbles, FNB – Fraction of Negative Bubbles

Category	Analyzed Assets	Fraction of Pos. Bubbles [%]	Fraction of Neg. Bubbles [%]
Fixed Income	155	3	0
Government Bonds	55	4	0
Finance and Insurance	21	0	0
Corporate Bonds	79	3	0
Equity	287	31	0
Country Indices	68	28	0
Europe	35	29	0
United States	184	33	0
Commodities	33	9	0
Forex	52	4	0

At the beginning of May, we observe an extraordinary increase in the fraction of positive bubble signals amongst equity indices. In more detail, about one third of all analyzed equity indices across all subsectors are found to exhibit positive bubble activity.

We furthermore report an increase in the fraction of positive bubbles for all other asset classes, as well as a decrease in the negative bubble fraction of commodities, as compared to the previous month.
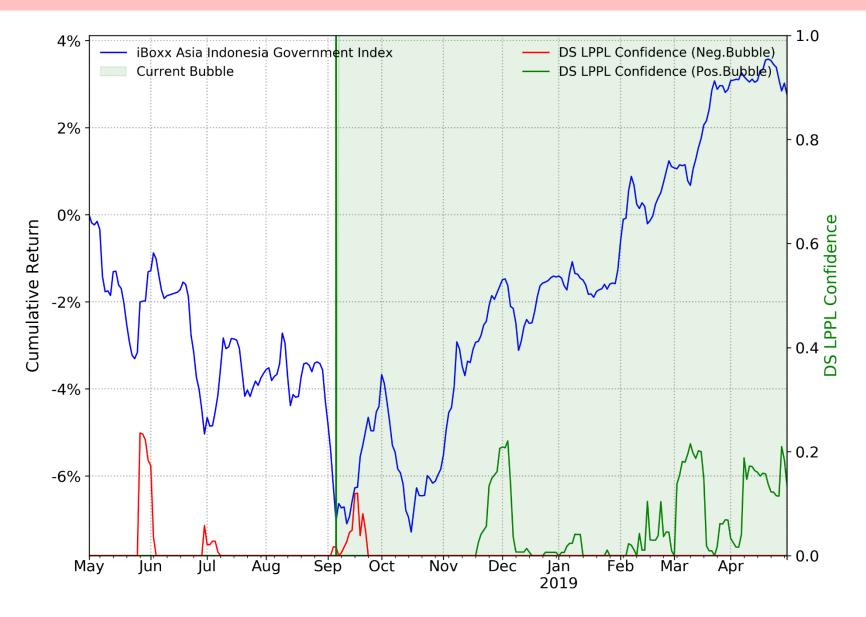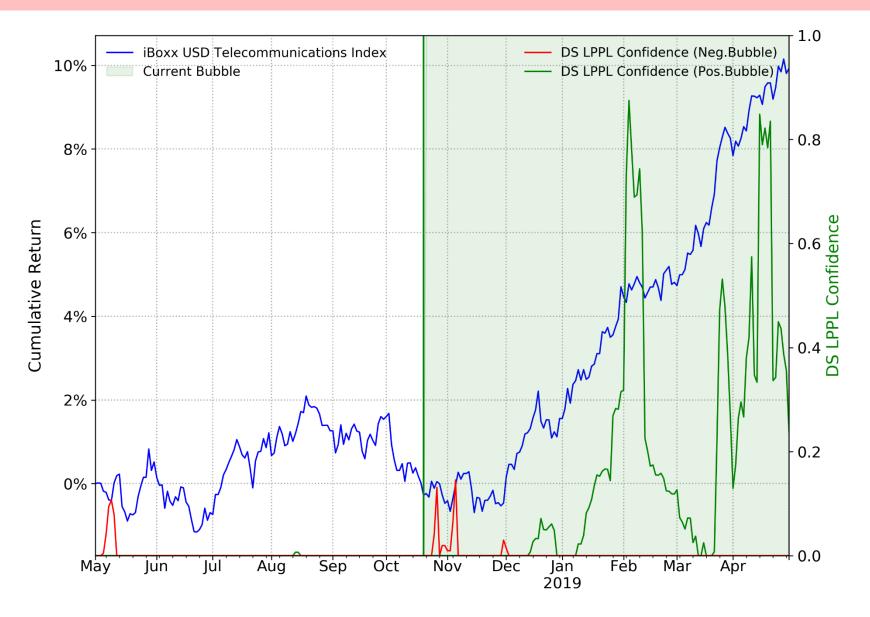
| Bubble Data | | | | | Cluster Analysis | | |
Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles							
1 iBoxx Asia Indonesia Government Index	11	235	29	18	2019-05-02	5	41
Positive Bubbles							
1 iBoxx USD Telecommunications Index	10	192	33	18	2019-07-17	15	77

In the fixed income sector, we observe a low bubble activity of 3% this month. The two table rows for positive bubbles shown above list the detected bubble signals for the government bond and the corporate bond sectors, respectively. The corresponding indicator plots are depicted on the following slides.
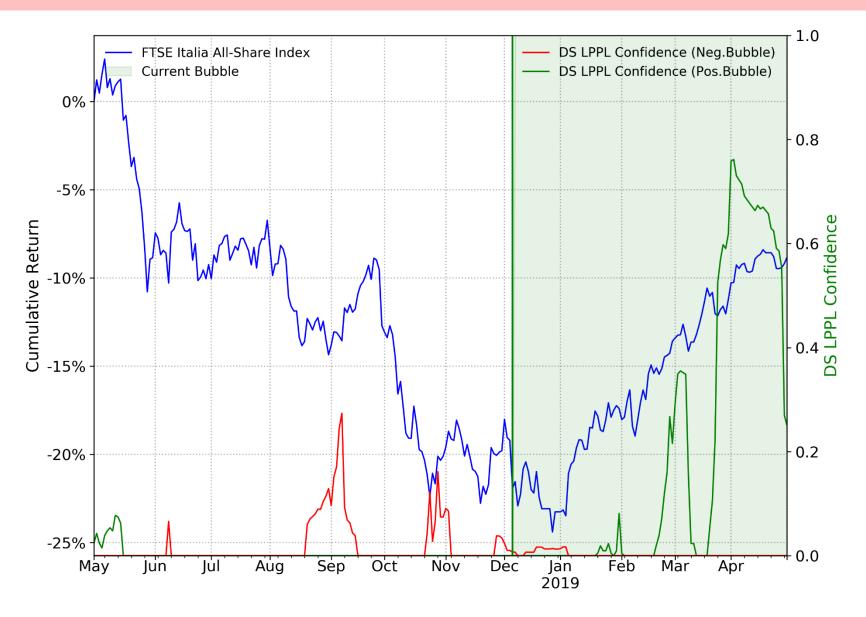
Entrepreneurial Risks
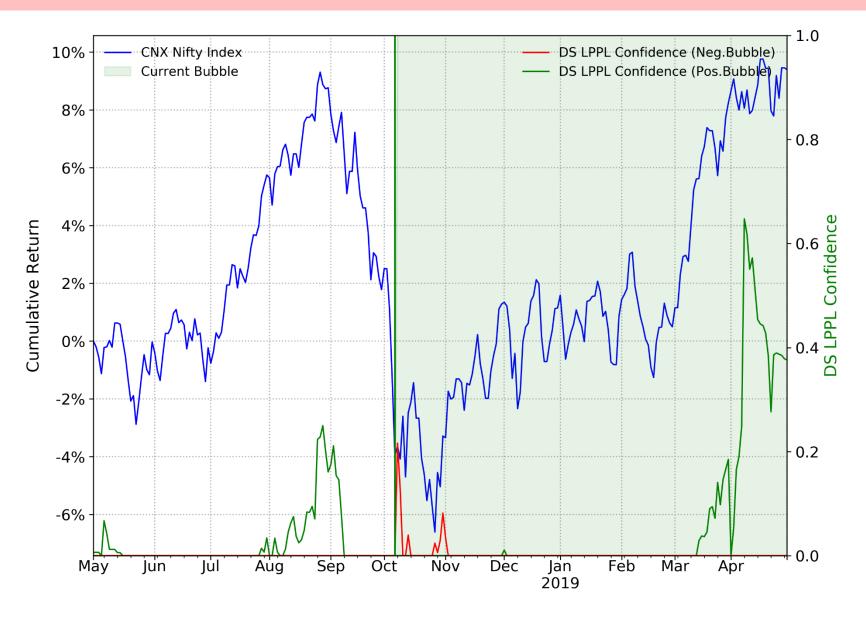**ETH** *zürich*

		Bubble Data				Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	FTSE Italia All-Share Index	16	144	77	35	2019-05-06	2	34
2	FTSE MIB Index	17	144	70	34	2019-05-06	3	43
3	CNX Nifty Index	14	206	82	34	2019-06-03	1	32
4	Austrian Traded Index	19	129	52	31	2019-04-30	1	36
5	NASDAQ Composite Index	20	114	47	30	2019-04-29		51

The most striking sector in this month's report is the equity sector, for which we determine an increase in the positive bubble activity from 9% in the past month to now 31%. Multiple different indices are listed at the top of our results table, covering the countries Italy, India, Austria, as well as the US market. The Italian indices were already mentioned in the previous report. The variety of appearing signals over the cross-section of these various markets can be interpreted as a strong signal for global rising bubble activity. The reported bubble sizes reach from 14% up to 20%, with a top confidence indicator value of 82%. These fairly high estimates should act as a warning and motivate the reader to further inspect the current market situation.
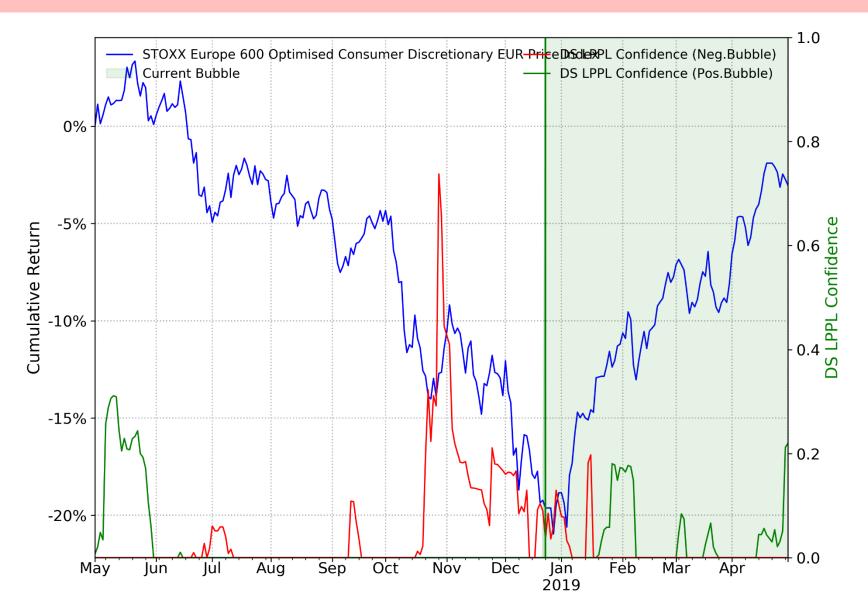
Bubble Data
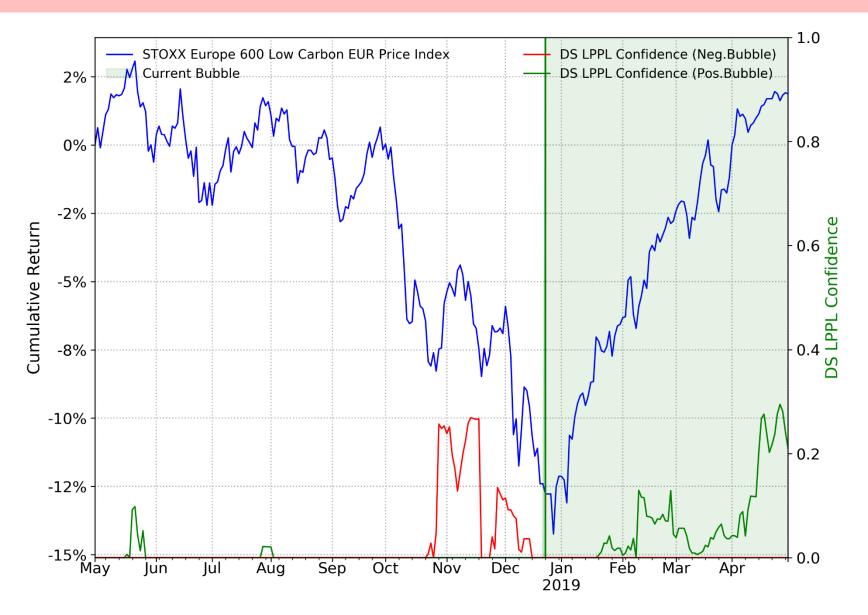
Cluster Analysis

Name	Bubble Size bs [%]	Duration [days]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [days]	Scenario Probability [%]
Positive Bubbles							
1 STOXX Europe 600 Optimised Consumer Discretion...	21	128	43	30	2019-06-07	5	37
2 STOXX Europe 600 Low Carbon EUR Price Index	17	128	30	23	2019-04-30	3	42
3 STOXX Europe 600 EUR Price Index	17	128	30	22	2019-04-29	1	41
4 STOXX Europe 600 Futures Replication EUR Price...	16	128	30	22	2019-04-29	1	41
5 STOXX Europe 600 Financials EUR Price Index	13	144	35	21	2019-04-30	2	44

Focusing on the European equity sector, we find a sudden strong increase month-to-month in the positive bubble fraction. Again, the top listed indices cover diverse market sectors. The following pages show more plots of the recent evolution of these indices. As these are subsectors of the STOXX 600 index family, they often correlate, which can be seen in the plots. However, reappearing signals on these slightly different time series help us to 'average out' noise from the analysis of the STOXX 600 index.
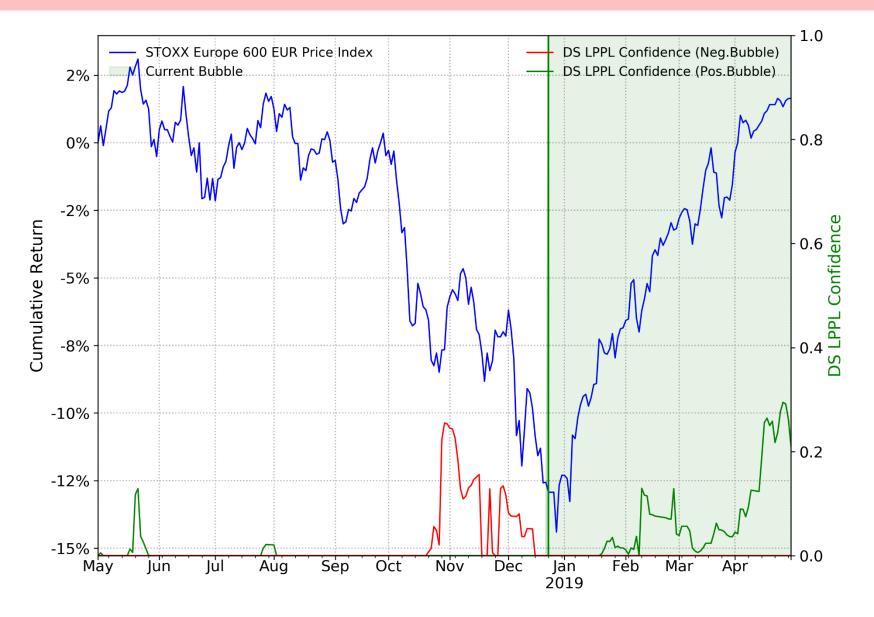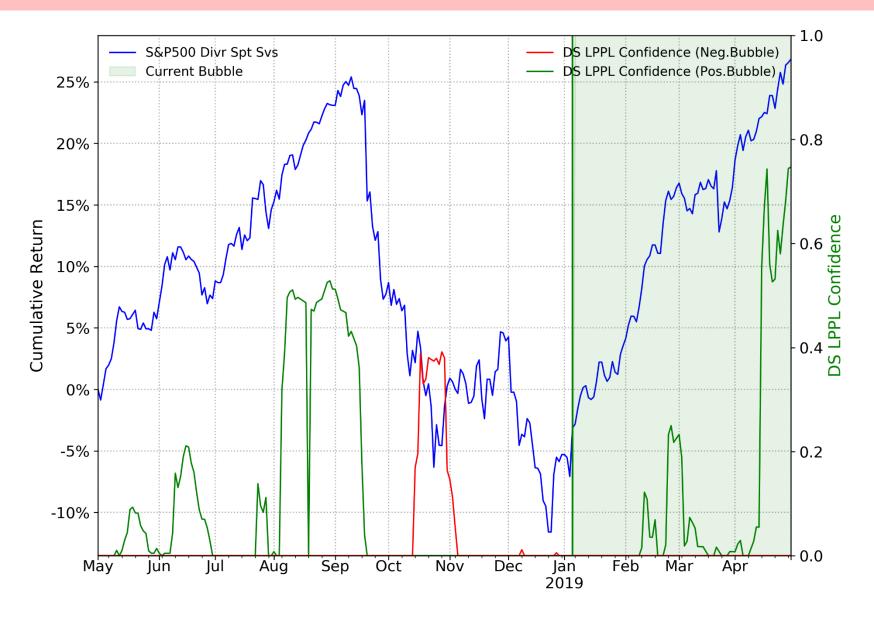
Equities – United States

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	S&P500 Divr Spt Svs	31	115	89	52	2019-05-02		49
2	S&P500 Es Info Technology	27	114	85	48	2019-05-01	2	88
3	S&P500 Elec Manu Svs	33	135	64	46	2019-05-02	2	74
4	S&P500 Distillers & Vintners	29	108	67	44	2019-05-02	3	56
5	S&P500 It Services	28	124	58	40	2019-05-14	3	35

As in the European equities sector, United States equity indices show a remarkably higher number of positive bubble signals this month. The identified bubble durations are in the range of three to five months, coinciding with the trough seen in markets at the beginning of 2019, from which prices strongly rose year-to-date, so far. Estimated bubble sizes are relatively high, at about 30% magnitude, as well as the confidence indicator values which range between 58-89%. Thus, the detected signals are stronger in magnitude than for European equities, due to larger recent growth of the US market.
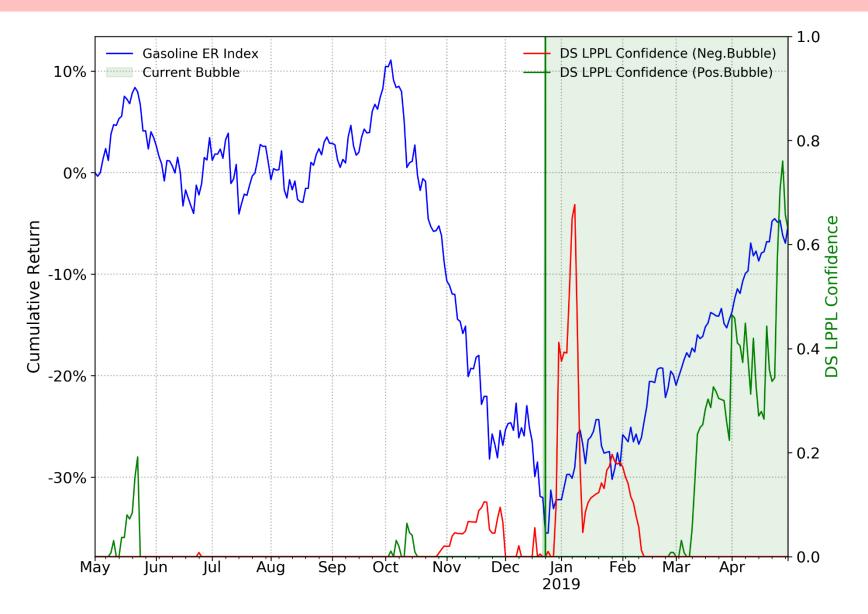
Commodities

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [*days*]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [*days*]	Scenario Probability [%]
Positive Bubbles								
1	Gasoline ER Index	44	128	74	57	2019-05-29	1	25
2	Petroleum ER Index	27	115	29	28	2019-06-18	6	51
3	Energy ER Index	24	130	14	18	2019-06-16	8	64

We furthermore report rising bubble activity in energy commodities, as embodied by the gasoline, petroleum and energy excess return indices. Again, these indices are highly correlated, which is why signals originate from very similar price patterns for all of them. The intensity of the signals however varies, with the largest estimated bubble size and confidence indicator values reported for gasoline. The corresponding time series are depicted on the following pages.
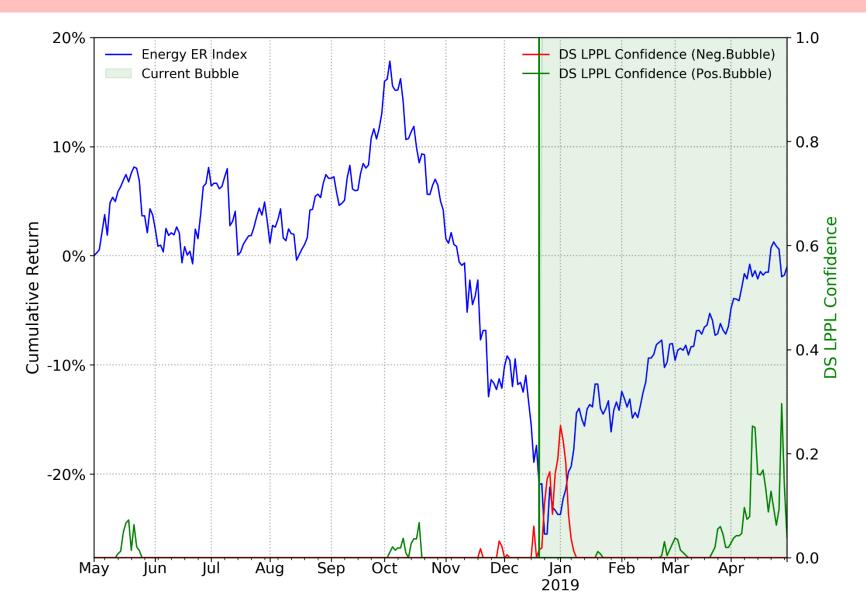
Currencies – REER Indices

		Bubble Data				Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	REER Index Morocco	12	243	77	30	2019-05-03	4	68
2	REER Index Ukraine	13	256	21	17	2019-08-27	21	66
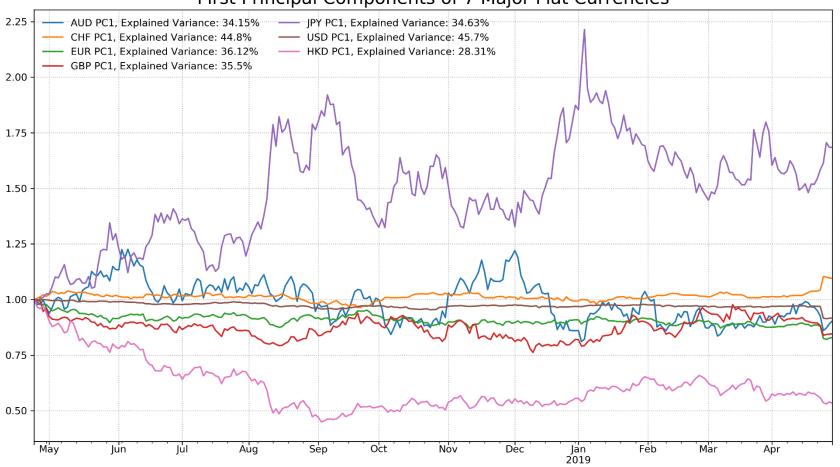
The analysis of real effective exchange rate (REER) indices reveals two indices that are in a positive bubble state. Although unrelated, the bubble sizes and durations approximately coincide, while however in case of the Morocco index, the confidence indicator is much larger.

The computation and analysis of Principal Component currency indices from various cross-rates does not yield any bubble signals. The time series are depicted on the following page.

Currencies – PCA

First Principal Components of 7 Major Fiat Currencies

Legend:
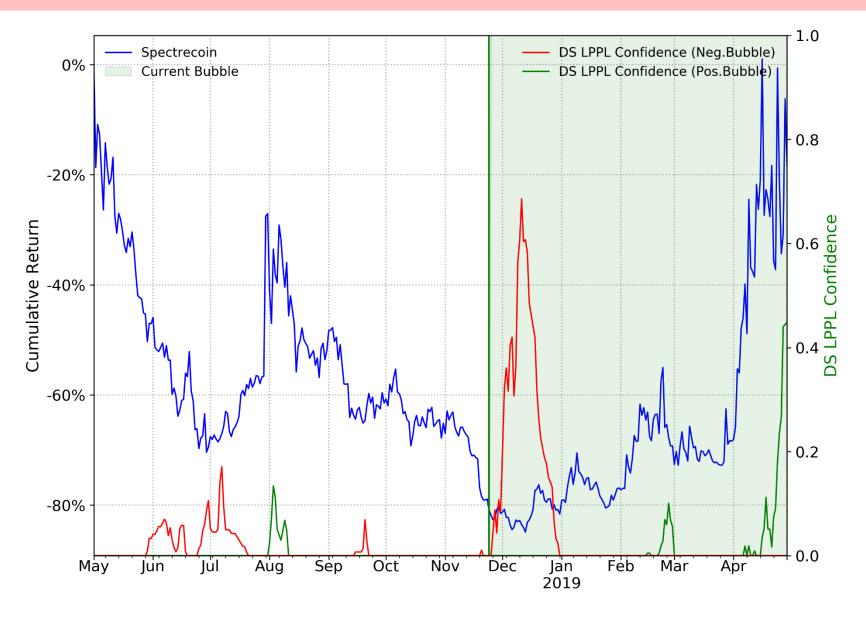- AUD PC1, Explained Variance: 34.15%
- CHF PC1, Explained Variance: 44.8%
- EUR PC1, Explained Variance: 36.12%
- GBP PC1, Explained Variance: 35.5%
- JPY PC1, Explained Variance: 34.63%
- USD PC1, Explained Variance: 45.7%
- HKD PC1, Explained Variance: 28.31%

Cryptocurrencies

| Bubble Data					Cluster Analysis		
Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles							
1 Spectrecoin	329	156	59	140	2019-05-08	1	72
2 Clams	447	144	38	131	2019-05-05	7	35
3 Numeraire	193	151	27	72	2019-05-30	18	84
4 Basic-Attention-Token	172	233	17	54	2019-06-12	18	50
5 Digixdao	41	127	67	52	2019-05-04	2	84
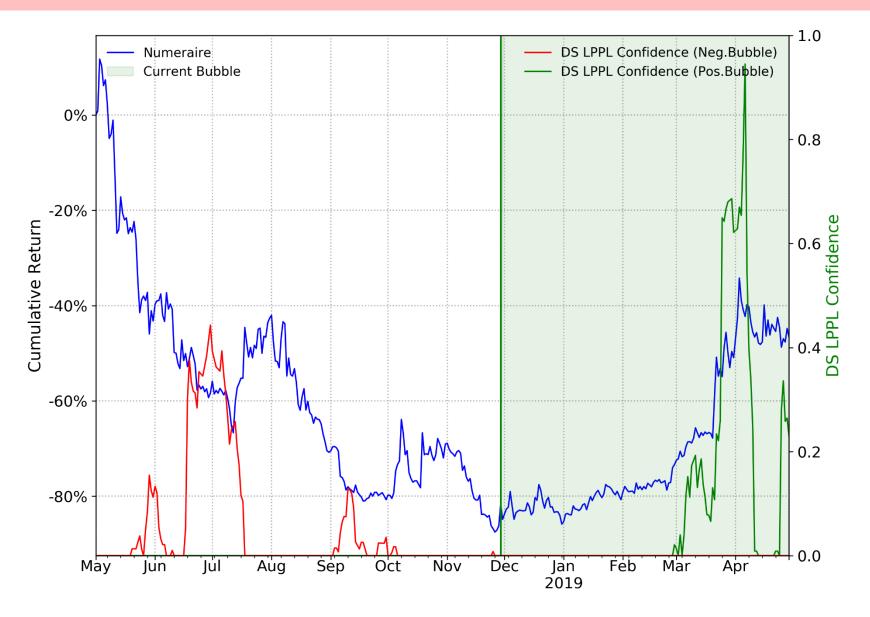
Various popular crypto-coins are in a positive bubble state. This, as already observed in the previous report, confirms that after months of corrections, low volatility and no signals, crypto-coin prices are increasing again. The corresponding plots for some of the coins are shown on the next pages.
Additionally, the burst of several short-lived (about four months) bubbles during the last month has been detected by our regime change detection procedures. The plots for the cryptocurrencies undergoing the largest crashes, namely All-Sports, Cortex and Medishares are also shown. For these cryptocurrencies, we report bubble sizes of up to about 230% and crash sizes of up to -80%, as mentioned in the captions of the plots. We also note that all detected crashes have occurred at approximately the same time.

Past Regime Change Detection: All-Sports
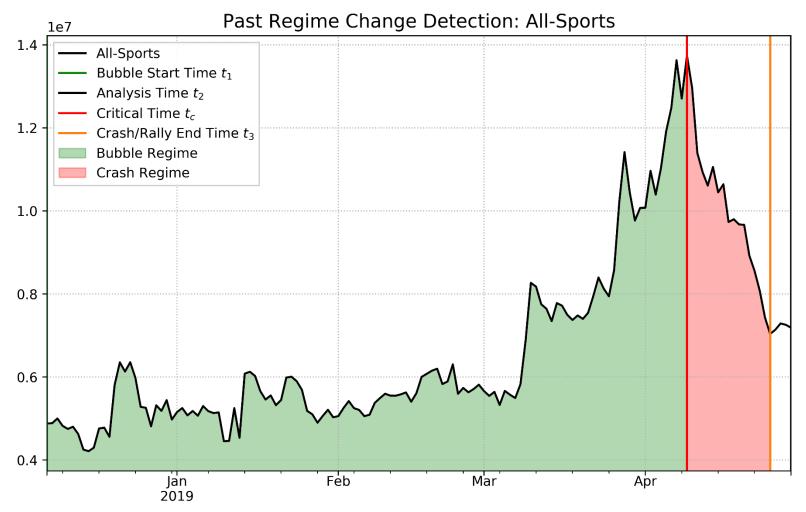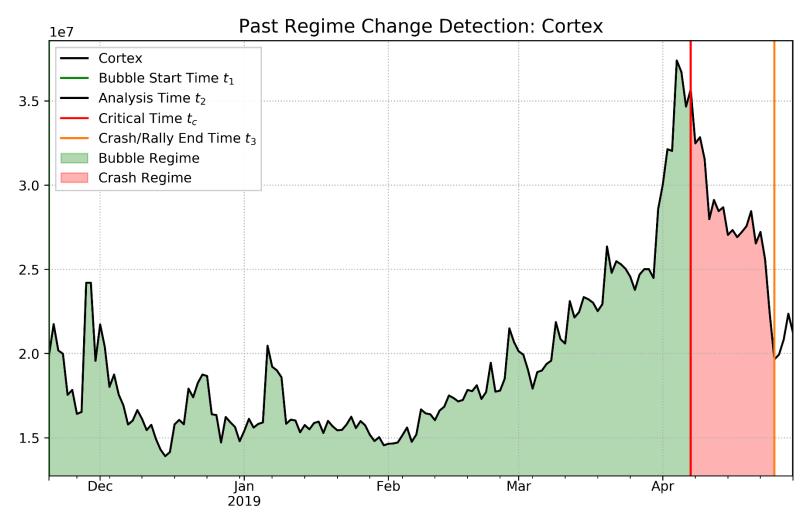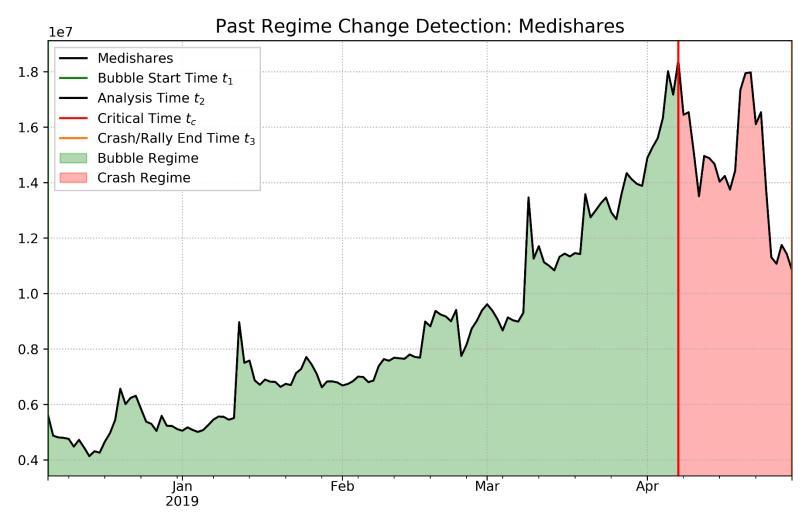
Bubble Size = 181.61%, Bubble Duration = 123days, Crash Size = -80.60%

Past Regime Change Detection: Cortex

Bubble Size = 79.28%, Bubble Duration = 138days, Crash Size = -76.39%

Past Regime Change Detection: Medishares

Legend:
- Medishares
- Bubble Start Time t_1
- Analysis Time t_2
- Critical Time t_c
- Crash/Rally End Time t_3
- Bubble Regime
- Crash Regime

Bubble Size = 227.41%, Bubble Duration = 122days, Crash Size = -69.78%

Single Stocks

For 824 stocks, we calculate the bubble warning indicators as well as two financial strength indicators, which indicate the fundamental value of the stock and the growth capability respectively.

The stocks are the constituents of the Stoxx Europe 600, the S&P 500 and the Nasdaq 100 indices. From these, all doubles and stocks with incomplete data are removed. Because our financial strength indicators are specifically designed for corporates, all financial institutions are taken out of the set as well.

List of Indicators
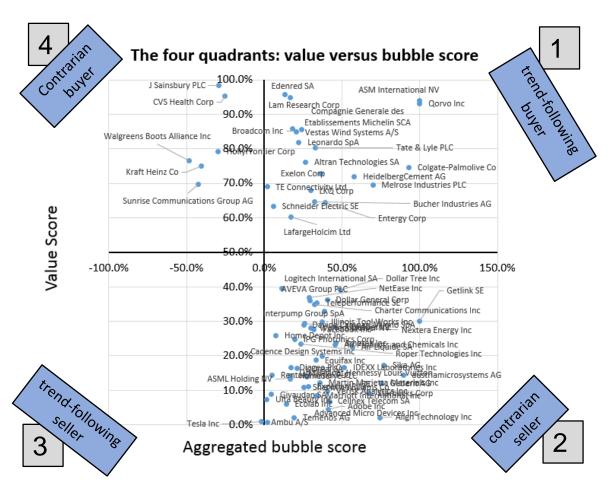
To analyze the financial strength of individual stocks, we have two indicators. Both scores give a value between zero and one, one being the best of the set and zero the worst, so the higher the score, the higher the financial strength.

- A value score that is based on the ROIC (Return on Invested Capital) taking into account the EV (Enterprise Value) to normalize for high/low market valuations and/or high/low debt; Value scores are calculated by comparing ROIC level versus EV/IC in each industry.
- A growth score that has characteristics similar to the PEG ratio, which is the Price to Earnings ratio normalized by the expected growth of the EPS (Earnings per Share).

Single Stocks

The four quadrants: value versus bubble score

4 Contrarian buyer

1 trend-following buyer

3 trend-following seller

2 contrarian seller

By plotting the value score against the aggregated bubble score, we can divide the stocks into four quadrants*:

1. Quadrant 1: Stocks with a strong positive bubble score and a strong value score (e.g. Sika AG);

2. Quadrant 2: Stocks with a strong positive bubble score and a weak value score (e.g. Tate & Lyle PLC);

3. Quadrant 3: Stocks with a strong negative bubble score and a weak value score (e.g. HeidelbergCement AG);

4. Quadrant 4: Stocks with strong negative bubble score and a strong financial strength (e.g. Exelon Corp)

*A strong positive bubble signal is identified if bubble score is larger than 10%, and a strong negative bubble signal is identified if bubble score is smaller than -10%. A strong value score is identified if value score is larger than 60%, and a weak value score is identified if value score is smaller than 40%.
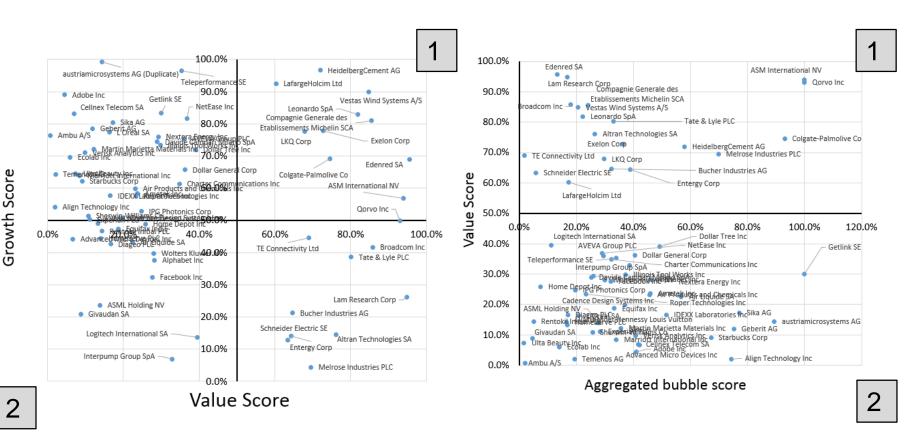
Single Stocks

Each quadrant has its own specs:

1. Quadrant 1: Stocks with a strong value score are cheap relative to their earnings potential. The strong positive bubble signal should be interpreted as a momentum indicator possibly the consequence of a repricing based on the fundamentals. As an investor, one could be a trend-following buyer.

2. Quadrant 2: Stocks with a weak value score are expensive relative to their earnings potential. The strong positive bubble signal is an indication of sentiment and herding increasing the price until it is not linked to fundamentals anymore. As an investor, one could be a contrarian seller.

3. Quadrant 3: These stocks are expensive relative to their earnings potential. On top of that, there are clear negative bubble signals. Such stocks should be considered as falling knives. As an investor, one could be a trend-following seller.

4. Quadrant 4: These stocks are cheap relative to their financial performance. The strong negative bubble signal is an indication of sentiment and herding. These stocks can be considered as over-sold. As an investor, one could be a contrarian buyer.

Single Stocks

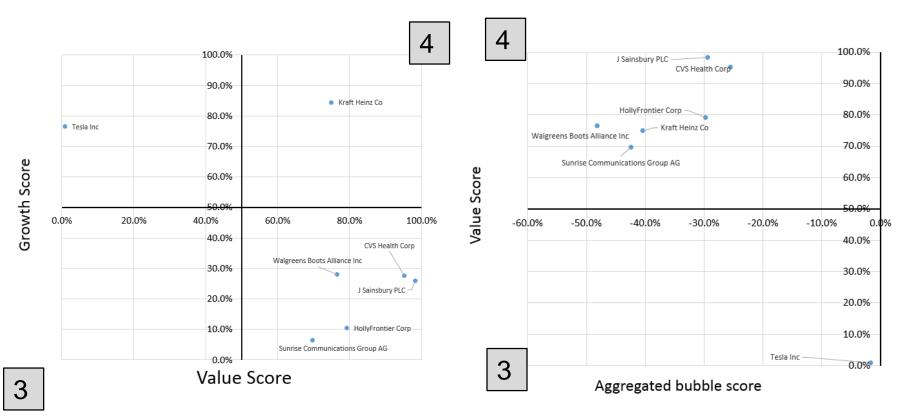## Quadrants 1 and 2 (stocks)
Strong positive bubble signals with strong (respectively weak) fundamentals

Single Stocks

Quadrants 3 and 4 (stocks)

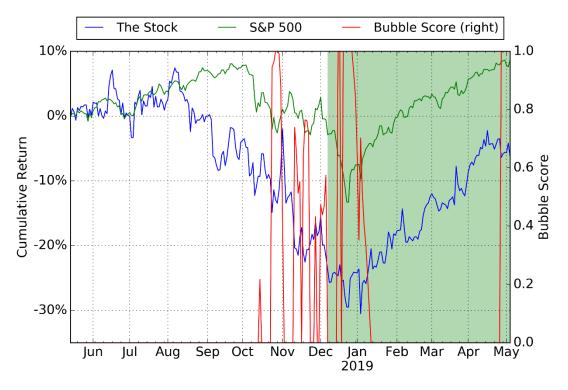Strong negative bubble signals with weak (respectively strong) fundamentals

Single Stocks

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Broadcom Inc	United States of America	Semiconductors & Semiconductor Equipment	31.8%	27.9%	Dec-18	18.0%	85.8%	41.6%
LKQ Corp	United States of America	Retailing	-5.7%	17.0%	Dec-18	29.8%	67.8%	77.5%
Lam Research Corp	United States of America	Semiconductors & Semiconductor Equipment	2.2%	48.6%	Oct-18	16.7%	94.9%	26.2%
Qorvo Inc	United States of America	Semiconductors & Semiconductor Equipment	-6.7%	23.0%	Dec-18	100.0%	93.1%	49.9%
HeidelbergCement AG	Germany	Materials	-10.5%	32.3%	Dec-18	57.9%	72.0%	96.6%
Vestas Wind Systems A/S	Denmark	Capital Goods	30.1%	20.5%	Nov-18	20.6%	84.8%	89.9%
Altran Technologies SA	France	Software & Services	-13.5%	50.3%	Dec-18	26.5%	76.1%	14.4%
Edenred SA	France	Commercial & Professional Services	49.7%	37.2%	Oct-18	13.3%	95.6%	68.9%
Compagnie Generale des Etablissements Michelin SCA	France	Automobiles & Components	-6.6%	29.8%	Oct-18	24.1%	85.6%	80.9%
Schneider Electric SE	France	Capital Goods	-3.5%	20.0%	Oct-18	5.9%	63.3%	12.9%
ASM International NV	Netherlands	Semiconductors & Semiconductor Equipment	13.5%	58.3%	Nov-18	100.0%	93.9%	56.9%
Leonardo SpA	Italy	Capital Goods	9.0%	21.7%	Dec-18	22.3%	81.9%	83.0%
Melrose Industries PLC	United Kingdom	Capital Goods	-14.5%	28.1%	Dec-18	69.8%	69.5%	4.4%
Bucher Industries AG	Switzerland	Capital Goods	-9.1%	28.3%	Nov-18	32.3%	64.7%	21.2%
LafargeHolcim Ltd	Switzerland	Materials	-1.3%	14.2%	Sep-18	17.4%	60.3%	92.5%
Tate & Lyle PLC	United Kingdom	Food, Beverage & Tobacco	27.3%	19.4%	Jun-18	33.0%	80.2%	38.6%
Colgate-Palmolive Co	United States of America	Household & Personal Products	15.5%	20.8%	Oct-18	93.0%	74.6%	69.2%
Entergy Corp	United States of America	Utilities	26.7%	24.3%	Jun-18	38.9%	64.3%	14.1%
Exelon Corp	United States of America	Utilities	26.8%	18.3%	Jul-18	36.3%	72.8%	77.8%
TE Connectivity Ltd	Switzerland	Technology Hardware & Equipment	0.2%	18.3%	Oct-18	1.8%	68.9%	44.5%
Dometic Group AB (publ)	Sweden	Automobiles & Components	-1.2%	48.6%	43435	56.9%	87.1%	7.2%
Loomis AB	Sweden	Commercial & Professional Services	7.1%	20.3%	43313	18.1%	62.6%	16.9%
Sandvik AB	Sweden	Capital Goods	6.0%	16.9%	43374	6.6%	63.6%	2.9%
Telefonaktiebolaget LM Ericsson	Sweden	Technology Hardware & Equipment	36.5%	34.1%	43252	29.8%	72.9%	85.2%
Volvo AB	Sweden	Capital Goods	-6.9%	27.3%	43435	99.8%	66.5%	13.2%

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals
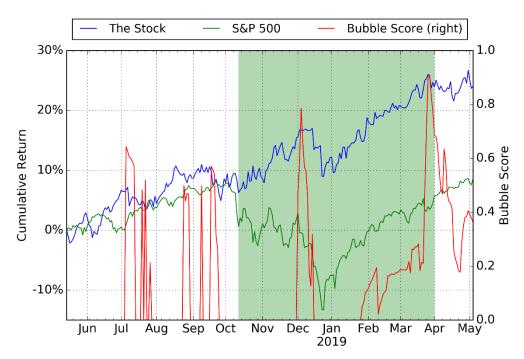Example: Qorvo Inc.

The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this five month bubble has reached 100% with a bubble size 23%.

Last month example: strong positive bubble signals with strong fundamentals, Exelon Corp.

The figure below plots the one year cumulative return of the stock (blue), S&P 500 (green) and LPPLS Bubble Score (red lines on the right y-axis). The green shaded period is the strong positive bubble we identified and reported last month. The stock stopped its appreciation and went into a plateau in the past month, which is in agreement with our DS LPPLS indicator. This stock, which is still identified with a strong bubble signal this month, has some potential for growth, given its strong fundamentals.

Single Stocks - Quadrant 2 stocks

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Adobe Inc	United States of America	Software & Services	20.6%	20.0%	Oct-18	40.9%	4.5%	89.0%
Align Technology Inc	United States of America	Health Care Equipment & Services	13.1%	52.4%	Nov-18	74.2%	1.9%	54.1%
Advanced Micro Devices Inc	United States of America	Semiconductors & Semiconductor Equipment	120.1%	46.4%	Oct-18	42.2%	6.7%	44.2%
ASML Holding NV	Netherlands	Semiconductors & Semiconductor Equipment	3.1%	23.5%	Nov-18	27.6%	13.8%	23.7%
Cadence Design Systems Inc	United States of America	Software & Services	69.2%	69.2%	May-18	37.1%	19.8%	50.7%
Charter Communications Inc	United States of America	Media & Entertainment	40.8%	29.7%	Jul-18	32.2%	34.8%	61.4%
Dollar Tree Inc	United States of America	Retailing	15.4%	36.4%	Aug-18	49.2%	39.1%	72.0%
Facebook Inc	United States of America	Media & Entertainment	6.4%	23.1%	Oct-18	32.0%	27.7%	32.3%
Alphabet Inc	United States of America	Media & Entertainment	9.9%	10.6%	Oct-18	45.8%	28.3%	37.6%
IDEXX Laboratories Inc	United States of America	Health Care Equipment & Services	28.1%	26.0%	Nov-18	51.5%	16.5%	57.6%
IPG Photonics Corp	United States of America	Technology Hardware & Equipment	-30.5%	29.2%	Oct-18	19.6%	24.8%	52.8%
Marriott International Inc	United States of America	Consumer Services	1.3%	26.0%	Dec-18	34.0%	8.5%	63.8%
NetEase Inc	China	Media & Entertainment	16.0%	37.1%	Aug-18	29.1%	36.9%	81.7%
Starbucks Corp	United States of America	Consumer Services	36.5%	21.0%	Nov-18	67.2%	9.1%	62.1%
Ulta Beauty Inc	United States of America	Retailing	32.7%	40.4%	Jul-18	1.6%	7.4%	64.6%
Verisk Analytics Inc	United States of America	Commercial & Professional Services	36.9%	24.4%	Oct-18	40.7%	9.8%	71.0%
AVEVA Group PLC	United Kingdom	Software & Services	40.3%	26.3%	Oct-18	29.6%	36.0%	75.4%
Diageo PLC	United Kingdom	Food, Beverage & Tobacco	18.3%	27.1%	Oct-18	17.0%	16.6%	42.6%
Ambu A/S	Denmark	Health Care Equipment & Services	0.2%	32.5%	Oct-18	2.0%	0.7%	76.3%
Cellnex Telecom SA	Spain	Telecommunication Services	21.1%	26.6%	Oct-18	41.7%	6.9%	83.1%
Experian PLC	Ireland; Republic of	Commercial & Professional Services	22.8%	25.6%	Oct-18	28.4%	11.0%	50.2%
Air Liquide SA	France	Materials	5.9%	15.3%	Nov-18	56.8%	22.5%	43.2%
Getlink SE	France	Transportation	21.8%	26.9%	Nov-18	100.0%	30.0%	83.3%
LVMH Moet Hennessy Louis Vuitton SE	France	Consumer Durables & Apparel	15.1%	39.9%	Nov-18	16.8%	13.3%	49.0%
L'Oreal SA	France	Household & Personal Products	18.6%	31.1%	Oct-18	20.9%	16.3%	77.3%

Single Stocks - Quadrant 2 stocks

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Teleperformance SE	France	Commercial & Professional Services	23.7%	12.4%	Oct-18	34.0%	35.3%	96.5%
Wolters Kluwer NV	Netherlands	Commercial & Professional Services	32.6%	19.9%	Oct-18	29.9%	28.0%	39.8%
HomeServe PLC	United Kingdom	Commercial & Professional Services	32.1%	20.1%	Dec-18	16.7%	14.1%	44.4%
Davide Campari Milano SpA	Italy	Food, Beverage & Tobacco	39.7%	20.1%	Nov-18	25.3%	29.0%	74.4%
Interpump Group SpA	Italy	Capital Goods	17.2%	21.4%	Jun-18	38.7%	32.9%	6.9%
Rentokil Initial PLC	United Kingdom	Commercial & Professional Services	19.3%	14.2%	Jul-18	5.0%	14.3%	46.6%
austriamicrosystems AG (Duplicate)	Austria	Semiconductors & Semiconductor Equipment	-48.5%	103.3%	Dec-18	89.4%	14.4%	99.2%
Geberit AG	Switzerland	Capital Goods	3.5%	20.7%	Oct-18	75.2%	11.9%	78.5%
Givaudan SA	Switzerland	Materials	15.3%	14.8%	Jul-18	4.5%	8.7%	20.9%
Logitech International SA	Switzerland	Technology Hardware & Equipment	1.0%	16.4%	Oct-18	11.3%	39.4%	13.6%
Sika AG	Switzerland	Materials	13.7%	24.2%	Nov-18	77.0%	17.2%	80.5%
Temenos AG	Switzerland	Software & Services	15.7%	27.8%	Oct-18	19.3%	2.1%	64.3%
Ametek Inc	United States of America	Capital Goods	16.0%	21.9%	Nov-18	46.0%	23.7%	58.3%
Air Products and Chemicals Inc	United States of America	Materials	25.7%	36.7%	Oct-18	45.7%	23.2%	59.8%
Dollar General Corp	United States of America	Retailing	29.0%	32.4%	Jun-18	40.4%	36.3%	65.7%
Ecolab Inc	United States of America	Materials	25.8%	26.8%	Oct-18	14.1%	5.9%	69.5%
Equifax Inc	United States of America	Commercial & Professional Services	8.3%	26.3%	Oct-18	33.3%	18.7%	47.3%
Home Depot Inc	United States of America	Retailing	8.2%	11.2%	Oct-18	7.5%	25.8%	48.8%
Illinois Tool Works Inc	United States of America	Capital Goods	8.0%	22.6%	Oct-18	37.3%	29.7%	73.3%
Martin Marietta Materials Inc	United States of America	Materials	3.7%	31.1%	Oct-18	35.7%	12.3%	72.2%
Nextera Energy Inc	United States of America	Utilities	23.0%	18.0%	Jun-18	26.0%	29.2%	76.0%
Roper Technologies Inc	United States of America	Capital Goods	30.9%	29.1%	Oct-18	23.5%	23.3%	57.5%
Sherwin-Williams Co	United States of America	Materials	19.9%	13.7%	Dec-18	25.6%	10.8%	51.5%
Vulcan Materials Co	United States of America	Materials	2.0%	29.9%	43374	28.9%	5.8%	50.1%
Xylem Inc	United States of America	Capital Goods	15.1%	23.1%	43435	30.4%	19.3%	69.1%
Yum! Brands Inc	United States of America	Consumer Services	23.8%	15.4%	43405	52.0%	9.2%	88.5%
Husqvarna AB	Sweden	Consumer Durables & Apparel	1.5%	31.4%	43374	32.8%	20.5%	93.2%

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals
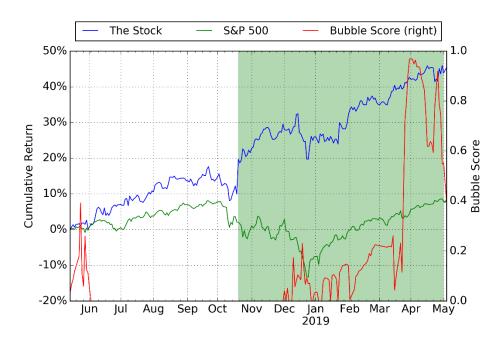Example: Getlink SE.

The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the positive bubble we identified. The Bubble Score of this five month bubble has reached 100% with a bubble size 26.9%. The strong positive bubble signals and weak fundamentals indicate a high probability of correction in the future.

Last month example: strong positive bubble signals with weak fundamentals, Procter & Gamble Co.

The figure below plots the one year cumulative return of the stock (blue), S&P 500 (green) and LPPLS Bubble Score (red lines on the right y-axis). The green shaded period is the strong positive bubble we identified and reported last month. Note that the stock price entered into a volatile plateau continuing for the time being, which may indicate a change of regime. With the weak fundamentals and our DS LPPLS indicator, one should be careful about the downside risk of this stock.

Single Stocks - Quadrant 3 stocks

Quadrant 3 stocks: strong negative bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Tesla Inc	United States of America	Automobiles & Components	-10.4%	-19.7%	Jun-18	-1.8%	0.8%	76.5%
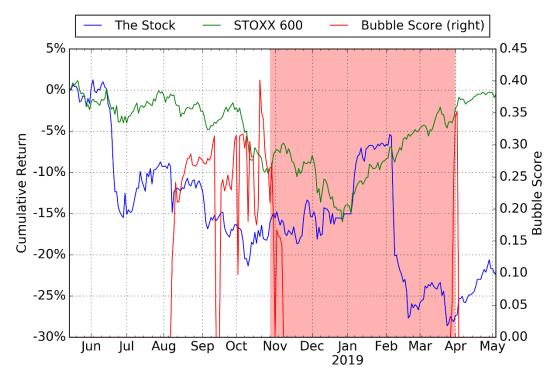
There is no stock identified in this quadrant with a strong negative bubble signal, this month.

The bubble score identified in Tesla Inc is very small, indicating a immature negative bubble that may or may not develop.

Last month example: strong negative bubble signals with weak fundamentals, DKSH Holding AG.

The figure below plots the one year cumulative return of the stock (blue), STOXX 600 (green) and LPPLS Bubble Score (red line on the right y-axis). The red shaded period is the strong negative bubble we identified and reported in last month. The stock had a strong rebound in the past month, which is in agreement with the DS LPPLS indicator, notwithstanding the weak fundamentals.
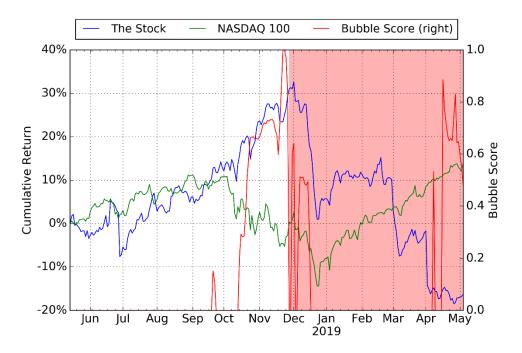
Single Stocks - Quadrant 4 stocks

Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Kraft Heinz Co	United States of America	Food, Beverage & Tobacco	-43.9%	-48.3%	Jun-18	-40.4%	75.0%	84.5%
Walgreens Boots Alliance Inc	United States of America	Food & Staples Retailing	-18.0%	-36.1%	Nov-18	-48.1%	76.5%	28.2%
Sunrise Communications Group AG	Switzerland	Telecommunication Services	-17.1%	-26.0%	Oct-18	-42.4%	69.7%	6.4%
J Sainsbury PLC	United Kingdom	Food & Staples Retailing	-28.3%	-28.1%	Oct-18	-29.4%	98.3%	26.0%
CVS Health Corp	United States of America	Health Care Equipment & Services	-13.8%	-27.9%	Sep-18	-25.5%	95.3%	27.5%
HollyFrontier Corp	United States of America	Energy	-35.5%	-30.5%	Jun-18	-29.8%	79.2%	10.4%

Quadrant 4 stocks: strong negative bubble signals with strong fundamentals
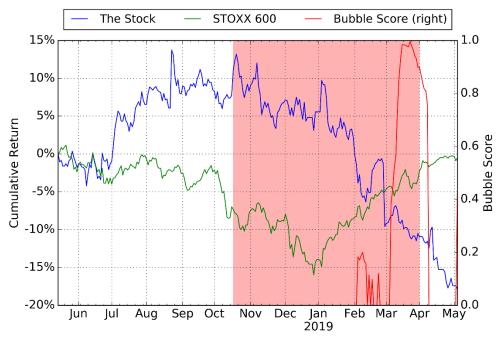Example: Walgreens Boots Alliance Inc.

The above graph shows the one year cumulative return of the stock in blue (left hand scale), NASDAQ 100 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this five month bubble has reached 48.1% with a bubble size -36.1%. We expect a rebound in the future, which is due to our diagnostic of a negative bubble signal with strong fundamentals, calling for a contrarian buyer position.

Last month example: strong negative bubble signals with strong fundamentals, Sunrise Communications Group AG.

The figure below plots the one year cumulative return of the stock (blue), STOXX 600 (green) and LPPLS Bubble Score (red line on the right y-axis). The red shaded period is the strong negative bubble we identified and reported in last month. The stock continued its drawdown in the past month, which is in contradiction with our DS LPPLS indicator and the strong fundamentals. We expect this stock to rebound in the future, given the maturing negative bubble and the strong fundamentals.
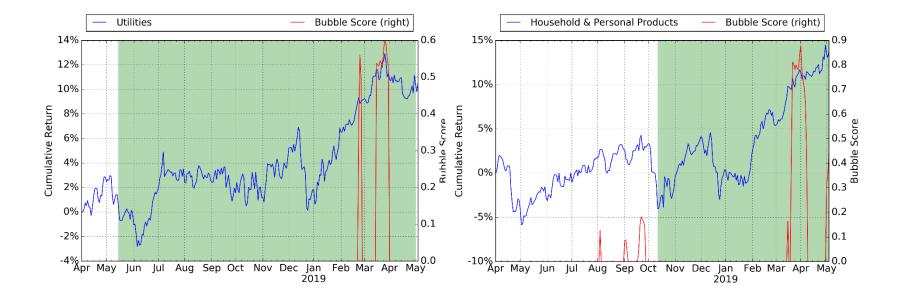
Sectors

| GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	May 1st	Apr 1st	May 1st	Apr 1st	May 1st	Apr 1st	May 1st	Apr 1st	May 1st	Apr 1st
Pharmaceuticals, Biotechnology & Life Sciences	6.6%	8.6%	0.0%	0.0%	0.0%	0.0%	71.0%	69.9%	50.3%	51.2%
Consumer Services	6.3%	2.3%	15.5%	0.0%	32.8%	0.0%	31.0%	30.0%	49.1%	50.6%
Retailing	13.6%	13.2%	0.0%	0.0%	0.0%	0.0%	20.1%	20.6%	55.7%	56.3%
Transportation	3.3%	3.9%	0.0%	0.0%	0.0%	0.0%	56.2%	57.7%	51.4%	50.7%
Consumer Durables & Apparel	-2.2%	-6.0%	0.0%	0.0%	0.0%	0.0%	34.1%	37.0%	55.4%	55.4%
Semiconductors & Semiconductor Equipment	1.6%	-4.5%	25.0%	0.0%	51.2%	0.0%	66.3%	63.6%	34.2%	32.7%
Technology Hardware & Equipment	9.7%	6.9%	0.0%	0.0%	0.0%	0.0%	69.6%	69.2%	43.7%	43.2%
Automobiles & Components	-16.2%	-21.0%	0.0%	0.0%	0.0%	0.0%	73.9%	74.7%	57.7%	57.8%
Telecommunication Services	-0.9%	-4.1%	0.0%	0.0%	0.0%	0.0%	65.6%	64.4%	34.9%	35.3%
Energy	-15.8%	-6.2%	0.0%	0.0%	0.0%	0.0%	53.6%	52.9%	49.9%	49.8%
Software & Services	16.8%	16.0%	20.4%	0.0%	41.4%	0.0%	36.0%	36.8%	47.1%	47.1%
Materials	-9.6%	-7.1%	0.0%	0.0%	0.0%	0.0%	53.9%	53.9%	46.4%	46.7%
Health Care Equipment & Services	5.4%	11.5%	0.0%	0.0%	0.0%	0.0%	60.3%	59.3%	50.3%	50.5%
Capital Goods	-1.7%	-5.4%	0.0%	0.0%	0.0%	0.0%	48.7%	47.4%	49.5%	49.8%
Media & Entertainment	25.1%	15.5%	20.9%	0.0%	52.8%	0.0%	35.0%	36.8%	44.7%	44.3%
Commercial & Professional Services	12.3%	8.4%	0.0%	0.0%	0.0%	0.0%	31.3%	31.4%	50.8%	51.0%
Food & Staples Retailing	5.7%	8.3%	0.0%	0.0%	0.0%	0.0%	52.0%	54.6%	52.9%	52.5%
Household & Personal Products	17.5%	11.3%	18.5%	16.3%	43.9%	84.0%	33.6%	33.7%	49.7%	50.1%
Food, Beverage & Tobacco	6.0%	-1.1%	0.0%	0.0%	0.0%	0.0%	46.8%	47.3%	54.0%	54.7%
Utilities	11.3%	11.6%	0.0%	10.3%	0.0%	53.2%	51.7%	51.8%	44.7%	46.0%
Insurance	1.8%	-3.3%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Real Estate	9.5%	10.7%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Diversified Financials	-4.0%	-9.6%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Banks	-9.7%	-16.3%	0.0%	0.0%	0.0%	0.0%	-	-	-	-

Sectors
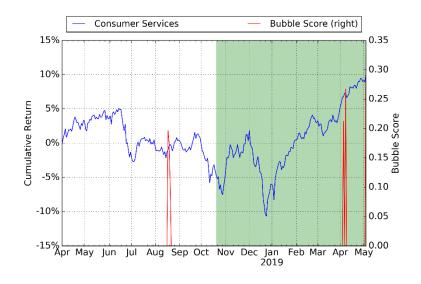
Since Dec 2017, we are using the MSCI World Industry Group Indices to calculate bubble size and bubble score of the corresponding sectors. To determine the value scores and growth scores of the sectors, we average over the corresponding values for each stock of a given sector, weighted by market cap.
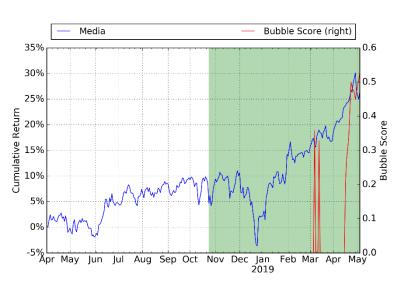
This month, we find 5 industry groups with a positive bubble score: *Household & Personal Products,* Consumer Services, *Semiconductors & Semiconductor Equipment, Software & Services,* and *Media & Entertainment*, as shown in the figure below and the next slide. The *Utilities* index has gone down significantly after our identification of a strong bubble score last month.
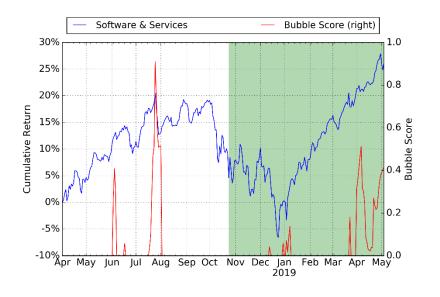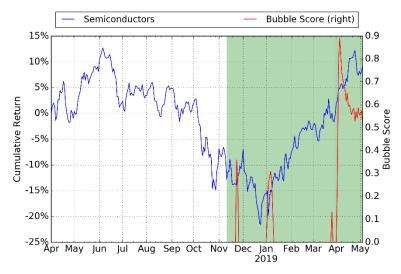
Sectors

Portfolio Construction & Performance

Here we illustrate the methodology of the portfolio construction process based on the results of our previous analyses.

For individual stocks that we identified in the 4 quadrants, we constructed 4 portfolios based on the 4 quadrants defined in the last report. Each portfolio consists of all the stocks listed in the corresponding quadrant.

(1)Trend-Following Long Stock Portfolio (TFLSP) is made of the stocks that have a positive bubble signal as well as a strong value score. For instance, TFLSP November consists of all the stocks listed in quadrant 1, identified in slide 37 of November 2017 FCO Report.

(2)Trend-Following Short Stock Portfolio (TFSSP) is made of the stocks that have a negative bubble signal as well as a weak value score.

(3)Contrarian Long Stock Portfolio (CLSP) is made of the stocks that have a negative bubble signal as well as a strong value score.

(4)and Contrarian Short Stock Portfolio (CSSP) is made of the stocks that have a positive bubble signal as well as a weak value score.
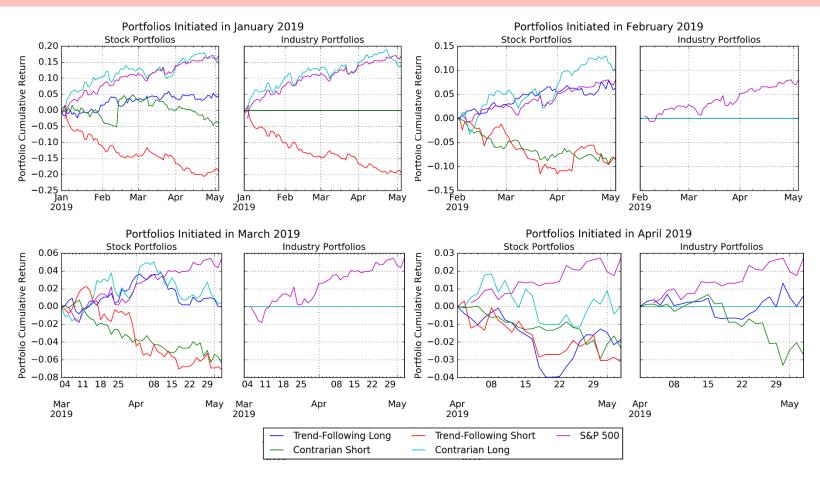
Portfolio Construction & Performance

At the same time, we also classified 20 industries into 4 quadrants, and constructed 4 type of industry portfolios based on the 4 industry quadrants. Each portfolio consists of all the stocks in the industries listed in the corresponding quadrant. Following the same definitions as above, we have Trend-Following Long Industry Portfolio (TFLIP), Trend-Following Short Industry Portfolio (TFSIP), Contrarian Long Industry Portfolio (CLIP), and Contrarian Short Industry Portfolio (CSIP).

In each month, we initiated 8 new portfolios based on the updated results. The performance of every 8 portfolios we initiated since November 2017 are presented in the next slide. All of the stocks in our portfolios are weighted by their market capitalizations and we don't consider transaction cost in the portfolio performance.

Since we started to use a new version of bubble signals and algorithm in November 2017, we only present the portfolios we initiated in November 2017 and later.

Portfolio Construction & Performance

This month, we find that Contrarian Long Portfolios outperformed among others due to the market appreciations in the past months, which contributes to drawdowns of Short Portfolios at the same time. Contrarian Portfolios are more delicate to use due to their sensitivity to timing the expected reversal and exhibit very volatile performances, indicating that most of bubbles in the market are still dominating and that fundamentals have not yet played out. We expect trend-following positions to perform in the months following the position set-up and then contrarian positions to over-perform over longer time scales as the predicted corrections play out.
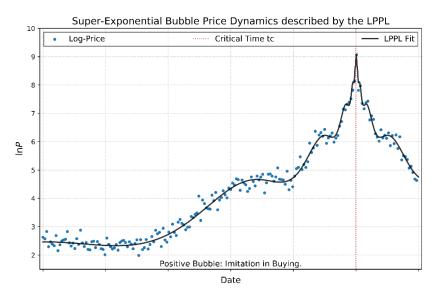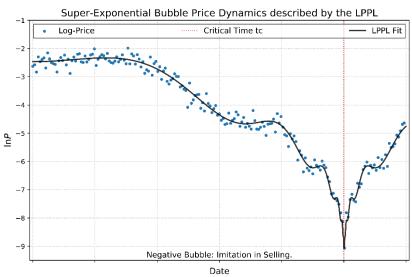
Appendix

Methodology

We use the Log-Periodic Power Law Singularity (LPPLS) model to hunt for the distinct fingerprint of Financial Bubbles. Basic assumptions of the model are:

1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.

2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in volatility towards the end of the bubble.

3. At the end of the bubble, the so-called critical time t_c, a finite time singularity occurs after which the bubble bursts.

Together, these effects encompass irrational imitation and herding phenomena amongst market participants that lead to blow-up and instability of asset prices.

Super-Exponential Bubble Price Dynamics described by the LPPL

Positive Bubble: Imitation in Buying.

Super-Exponential Bubble Price Dynamics described by the LPPL

Negative Bubble: Imitation in Selling.

The LPPLS Model

Mathematically, the simplest version of the log-periodic power law singularity model that describes the expected trajectory of the logarithmic price in a bubble is given as:

$$LPPLS := E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$
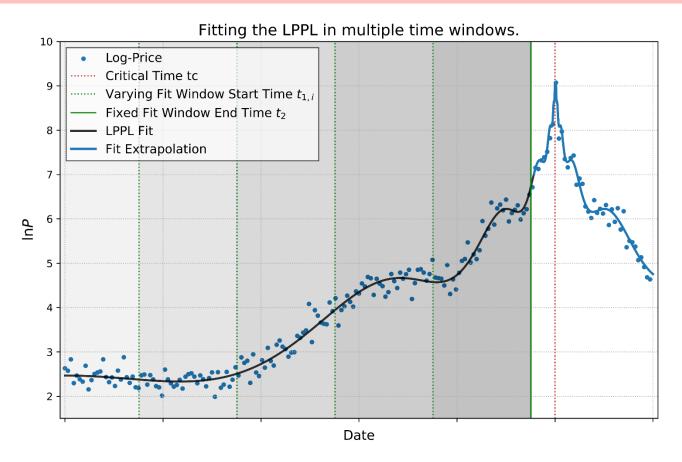
The seven parameters describing the model dynamics are:

- A The finite peak (valley) log-price at the time t_c when the positive (negative) bubble ends.
- m The power law exponent.
- B The power law intensity.
- $C_{1|2}$ Magnitude coefficients of the log-periodic accelerating oscillations.
- ω The log-periodic angular frequency of the log-periodic oscillations.
- t_c The critical time at which the bubble ends.

The set of seven model parameters is obtained by fitting the LPPLS formula to the price time series via a combination of Ordinary Least Squares and nonlinear optimization. The resulting values of the fit parameters reveal whether an asset is in a bubble state. Furthermore, the central parameter of interest, the critical time t_c, may warn of an imminent crash.

LPPLS Analysis of Price Time Series

Fitting the LPPL in multiple time windows.

Legend:
- Log-Price
- Critical Time tc
- Varying Fit Window Start Time $t_{1,i}$
- Fixed Fit Window End Time t_2
- LPPL Fit
- Fit Extrapolation

In order to avoid overfitting and to continuously collect information about price dynamics, we scan asset log-price trajectories for super-exponential price dynamics by sequentially fitting the LPPLS model in different time windows to the underlying price series. The procedure is illustrated in the plot.

For a fixed fit window end time, t_2, we select different window start times $t_{1,i}$ and fit the LPPL model in each of the resulting windows. This gives one set of calibrated LPPL parameters per fit window. In our monthly report, t_2, the time of analysis is always the start of the month, i.e. the report date (1st July 2018 for the present report).

As illustrated on the previous slide, for a fixed analysis time, t_2, we iteratively perform LPPLS fits over many different window start times $t_{1,i}$. Based on the resulting sets of fit parameters (one per fit window), we determine the bubble start time t_1^*, i.e. the time in the past at which the price (if it did) entered a super-exponential bubble phase from a previous phase of normal price growth. For more information on the determination of the bubble start time, we refer the reader to [1].

Next, we discard all fit results that correspond to windows with start time earlier than the bubble start time t_1^*. Then, we filter parameters in each of the remaining fit calibrations according to filter criteria established in [2]. The imposed filter boundaries are chosen such that only fits with model parameter values that likely correspond to real bubble dynamics are accepted. Such fits are then marked as qualified.

In order to fully capture the information that is contained in the remainder of the calibrations and condense it to a meaningful figure, we have developed the DS LPPLS Confidence Indicator. The indicator is calculated as the number of qualified fits divided by the total number of fits. It quantifies the presence of super-exponential price dynamics obtained over various differently sized time windows. A high value of the indicator signals that LPPLS signatures were detected on many timescales. A low value shows that almost no bubble dynamics were found.

We distinguish between a positive bubble and a negative bubble confidence indicator.

[1] Demos, Guilherme and Sornette, Didier, Lagrange Regularisation Approach to Compare Nested Data Sets and Determine Objectively Financial Bubbles' Inceptions (July 22, 2017). Swiss Finance Institute Research Paper No. 18-20. Available at SSRN: https://ssrn.com/abstract=3007070 or http://dx.doi.org/10.2139/ssrn.3007070

[2] A. Johansen and D. Sornette, Shocks, Crashes and Bubbles in Financial Markets, Brussels Economic Review (Cahiers economiques de Bruxelles) 53 (2), 201-253 (summer 2010) and papers at http://www.er.ethz.ch/media/publications/social-systems-finance/bubbles_and_crashes_theory_empirical_analyses.html

K-means Clustering for Critical Time Prediction

Following the methodology established in Gerlach, Demos and Sornette [1], we employ k-means clustering to our LPPLS calibration results to find possible future scenarios for the ending of a bubble. We are particularly interested in providing a prediction for the critical time t_c which, according to the mathematical definition of the log-periodic power law model, is the time at which we can expect the change of regime in the price of an asset to occur.

As we fit the LPPLS model on many different time window sizes, we often encounter variation in the LPPLS fit parameter sets that are obtained from each fit. The higher the similarity of the resulting parameter sets, the more we trust in their prediction for the critical time parameter. This idea of enhanced believability of results when they repetitively occur on multiple time scales is also the foundation of the DS LPPLS Confidence Indicator.

We detect similar LPPLS fits by applying k-means clustering to the set of LPPLS calibrations over all selected time windows. Here, we report the mean critical times μ_{t_c} and standard deviations σ_{t_c} of the largest such cluster. Furthermore, as complement to the Confidence Indicator, we report the associated scenario probability of the biggest cluster, defined as the number of members in the largest cluster divided by the total number of fits. The scenario probability is therefore a measure similar to the LPPLS Confidence, however with the difference that no constraints are imposed on the parameters to find qualified fits for the LPPLS confidence index.

[1] Gerlach, Demos and Sornette, Didier, Dissection of Bitcoin's Multiscale Bubble History (April 12, 2018). Swiss Finance Institute Research Paper No. 18-30. Available at SSRN: https://ssrn.com/abstract=3164246 or http://dx.doi.org/10.2139/ssrn.3164246

We present the monthly results of our bubble analysis in the form of a table such as the example given below.

In each table, we separately list assets that are in a positive, respectively, negative bubble state. Furthermore, the table is divided into two sections, bubble data and cluster analysis.

The first section provides asset and estimated bubble characteristics (size and duration), as well as the value of the confidence indicator. We rank assets according to their geometric average of the absolute of bubble size and confidence indicator. In this way, we incorporate the bubble size into the ranking.
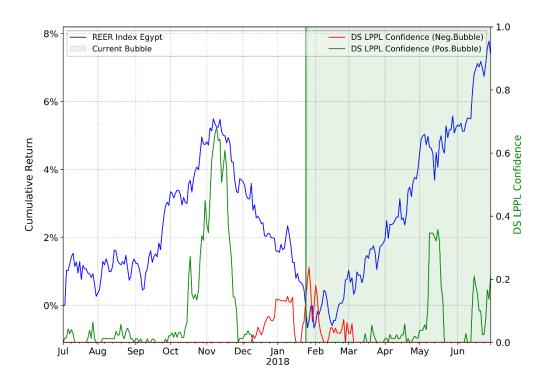
In the table section cluster analysis, the prediction data of the two most probable bubble burst scenarios are presented (see previous slide).

| | **Bubble Data** | | | | **Cluster Analysis** | | | |
	Name	**Bubble Size** bs [%]	**Duration** [days]	**DS LPPL Confidence** ci [%]	**Geometric Average** $\sqrt{bs \cdot ci}$ [%]	**Critical Time Prediction** μ_{t_c}	σ_{t_c} [days]	**Scenario Probability** [%]
Positive Bubbles								
1	iBoxx GEMX Kenya Index	11	276	24	16	2018-07-19	19	62
Negative Bubbles								
1								

Result Presentation

For each asset class, we also supply the confidence indicator time series for the bubble assets listed in the tables. The plot shows the cumulative return (left y-scale, in %) of the analyzed price trajectory (blue) since the beginning of the plot time range. We also plot the time series of the positive (green) and negative (red) DS LPPLS Confidence indicators (right y-scale). The indicator time series are calculated by repetitively applying the procedure described on the slide 'The DS LPPLS Confidence Indicator' over moving window end times t_2. Furthermore, if, at the last analyzed time, a non-zero indicator value results, i.e. the asset is presently in a bubble state, we outline the time interval for the positive (green shaded) or negative (red shaded) bubble from its beginning to present.

Real Effective Exchange Rate Indices

98 Real Effective Exchange Rate (REER) Indices for different currencies are investigated for bubble characteristics.

The (here CPI-weighted) REER Indices are a measure for the trading competitiveness of the corresponding country.

In contrast to single currency cross rates, the REER is a rather absolute measure of the domestic currency value because it is calculated versus a selection of other currencies.

This has the advantage that, unlike with the methodologies that were used in previous reports, positive and negative bubbles in the value of the currency can clearly be distinguished, as visible in the table above.

Currencies – Principal Component Analysis

As an alternative method to generate a base currency time series from a variety of the currency's cross rates, we apply a principal component analysis (PCA). In total, we perform the PCA for 10 major fiat currencies. For each currency, more than 100 cross rates are grouped into a time series dataset, which, using PCA, is then condensed down into a single time series to which we apply our LPPLS analysis. The time series is assembled according to the weights of the first principal component (PC1) of the dataset. It is used as an aggregate representation of all currency cross rates..

More precisely, taking for instance the Swiss franc as a base currency, we consider N=100 currency crosses expressing how much the Swiss franc is valued in these N other currencies. We calculate N time series of returns for the each cross with the base currency (Swiss franc). We then perform a PCA on the dataset of these N return time series. The corresponding PC1 represents the common factor explaining the largest part of the variance of the returns of these N time series. It is interpreted as the embodiment of the real Swiss franc dynamics, filtering out the impact of the other currencies. The LPPLS algorithm is then applied to this equivalent time series.

The plot given in the first part of the report depicts the equivalent time series constructed from the PC1 for each of the ten currency pairs. In the legend, the explained variance of the PC1 is given for each currency. A high explained variance means that most of the crosses of the base currency with other currencies move in a correlated way, which can be interpreted as reflecting a common factor, namely the base currency's intrinsic value dynamics.

Value and Growth Score

To analyze the financial strength of individual stocks in the second part of the report, we have two indicators. Both scores give a value between zero and one, one being the best of the set and zero the worst, so the higher the score, the higher the financial strength.

- A value score that is based on the ROIC (Return on Invested Capital) taking into account the EV (Enterprise Value) to normalize for high/low market valuations and/or high/low debt; Value scores are calculated by comparing ROIC level versus EV/IC in each industry.
- A growth score that has characteristics similar to the PEG ratio, which is the Price to Earnings ratio normalized by the expected growth of the EPS (Earnings per Share).

Visit the Financial Crisis Observatory for more information

http://www.er.ethz.ch/financial-crisis-observatory.html