

# The FCO Cockpit Global Bubble Status Report

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July 1<sup>st</sup>, 2019

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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.

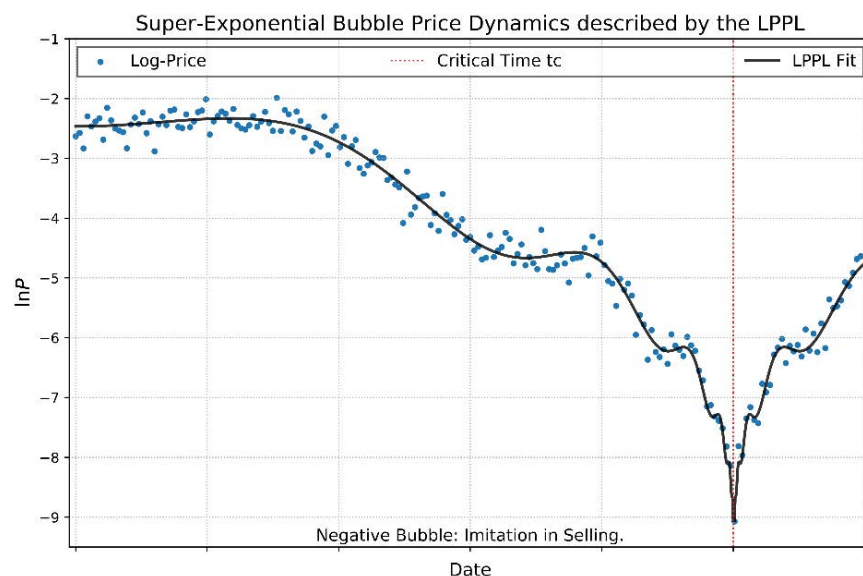
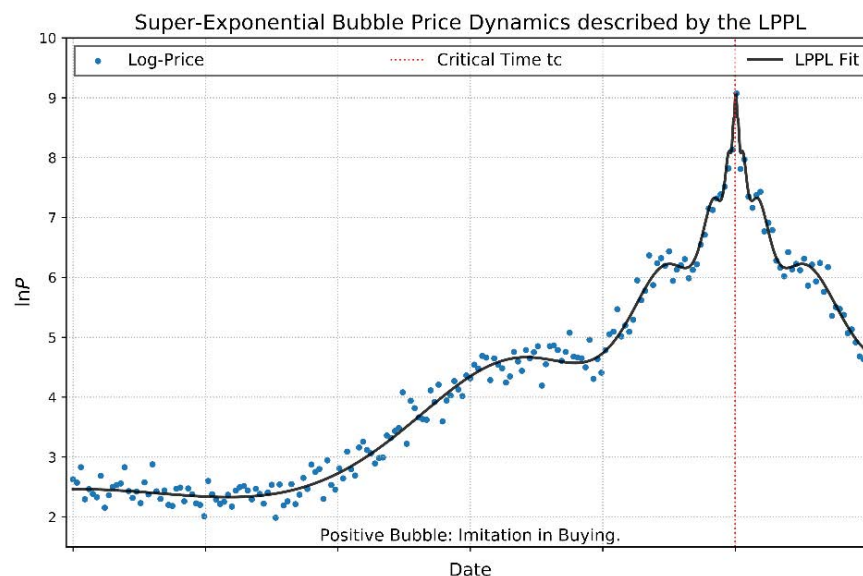
**To new readers, we recommend proceeding to the appendix for more detailed information about the methodology and procedures applied in this report.**

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>

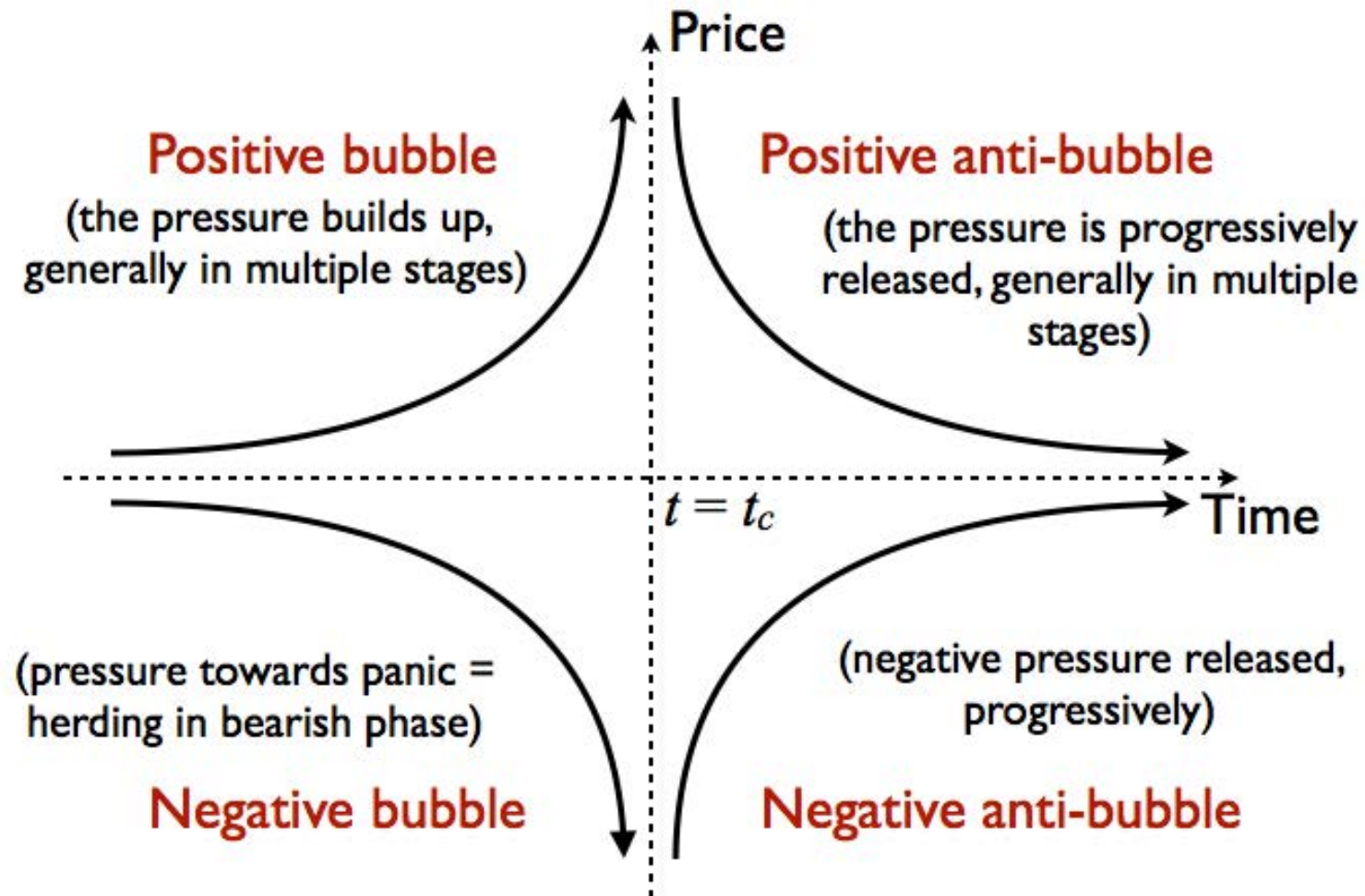
We use the Log-Periodic Power Law Singularity (LPPLS) model to hunt for the distinct fingerprint of **Financial Bubbles**. Basic assumptions of the model are:

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.

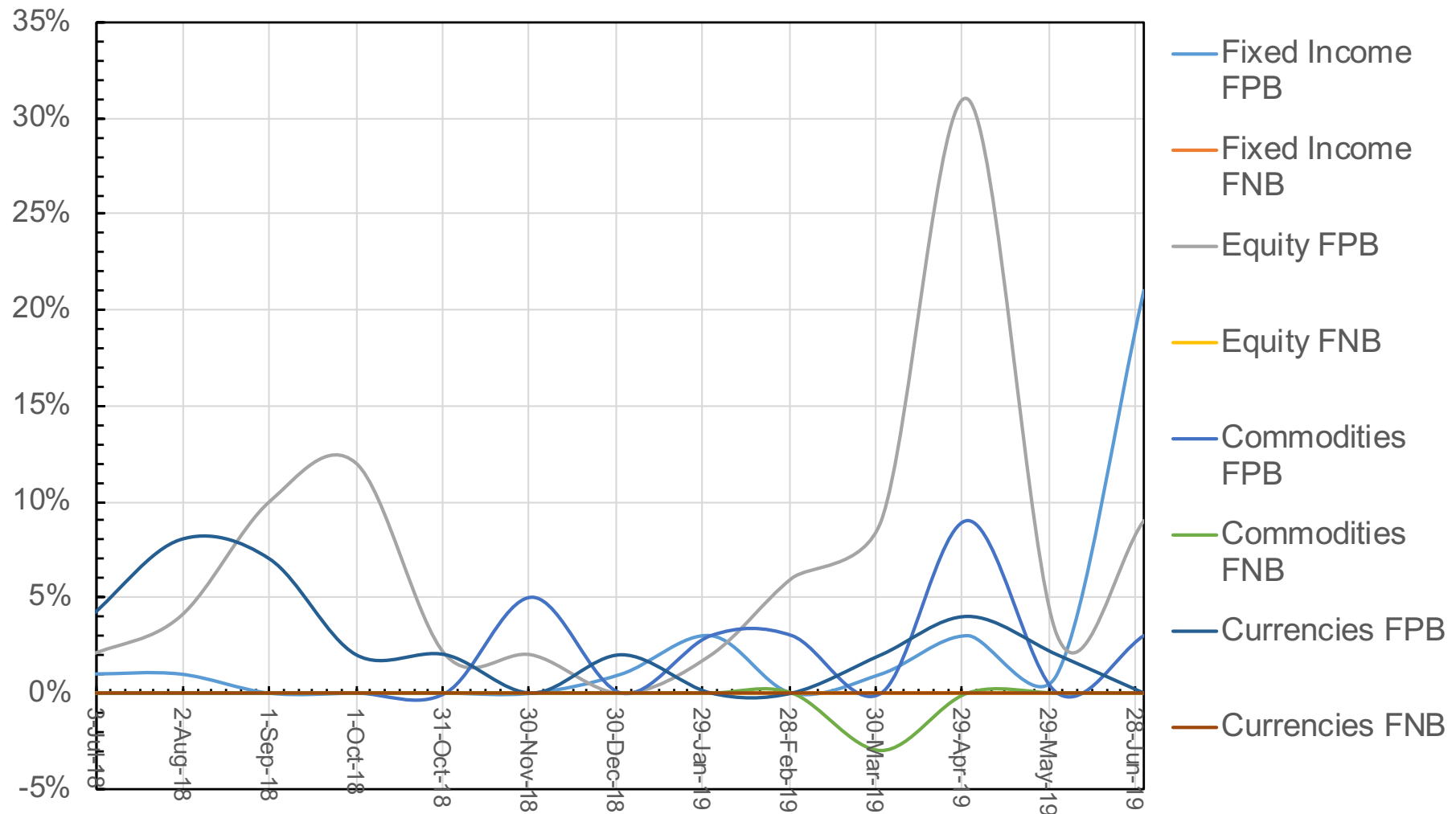


# Bubble Regimes



# General Results – The Big Picture

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



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

# General Results – This Month's Overview

Category	Analyzed Assets	Fraction of Pos. Bubbles [%]	Fraction of Neg. Bubbles [%]
<b>Fixed Income</b>	155	21	0
Government Bonds	55	11	0
Finance and Insurance	21	10	0
Corporate Bonds	79	32	0
<b>Equity</b>	267	9	0
Country Indices	63	5	0
Europe	35	0	0
United States	169	12	0
<b>Commodities</b>	31	3	0
<b>Forex</b>	56	0	0

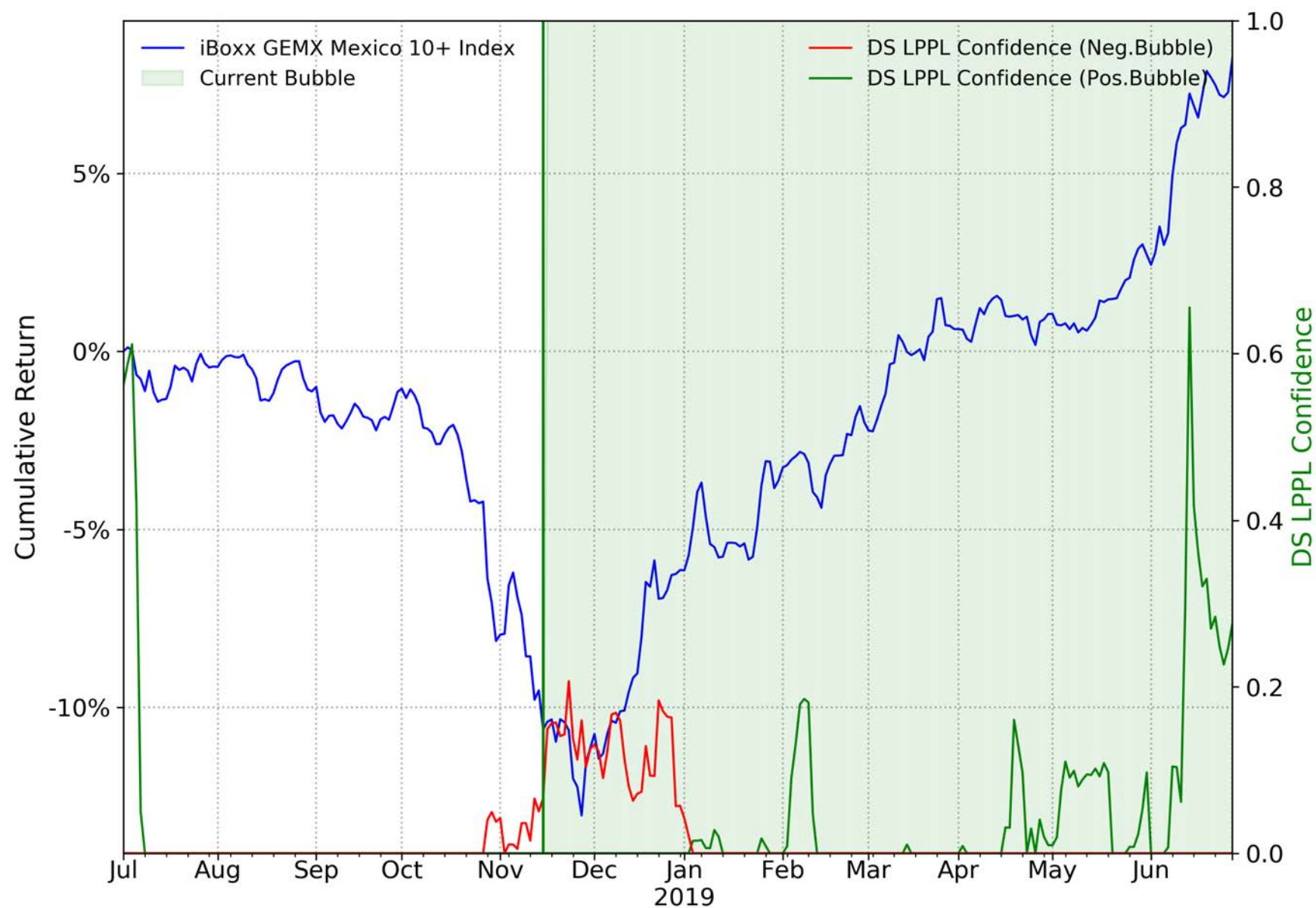
At the beginning of July, the fraction of positive bubbles in fixed income significantly increases, signaling a fast and intense surge in bubble activity in this sector after a low level of only 1% in the previous month. Furthermore, the equity sector shows slightly increased bubble activity of 9% (3% previously), as well. As in previous months, activity in the commodity and forex sectors remains low. Moreover, negative bubble activity is zero for all sectors.

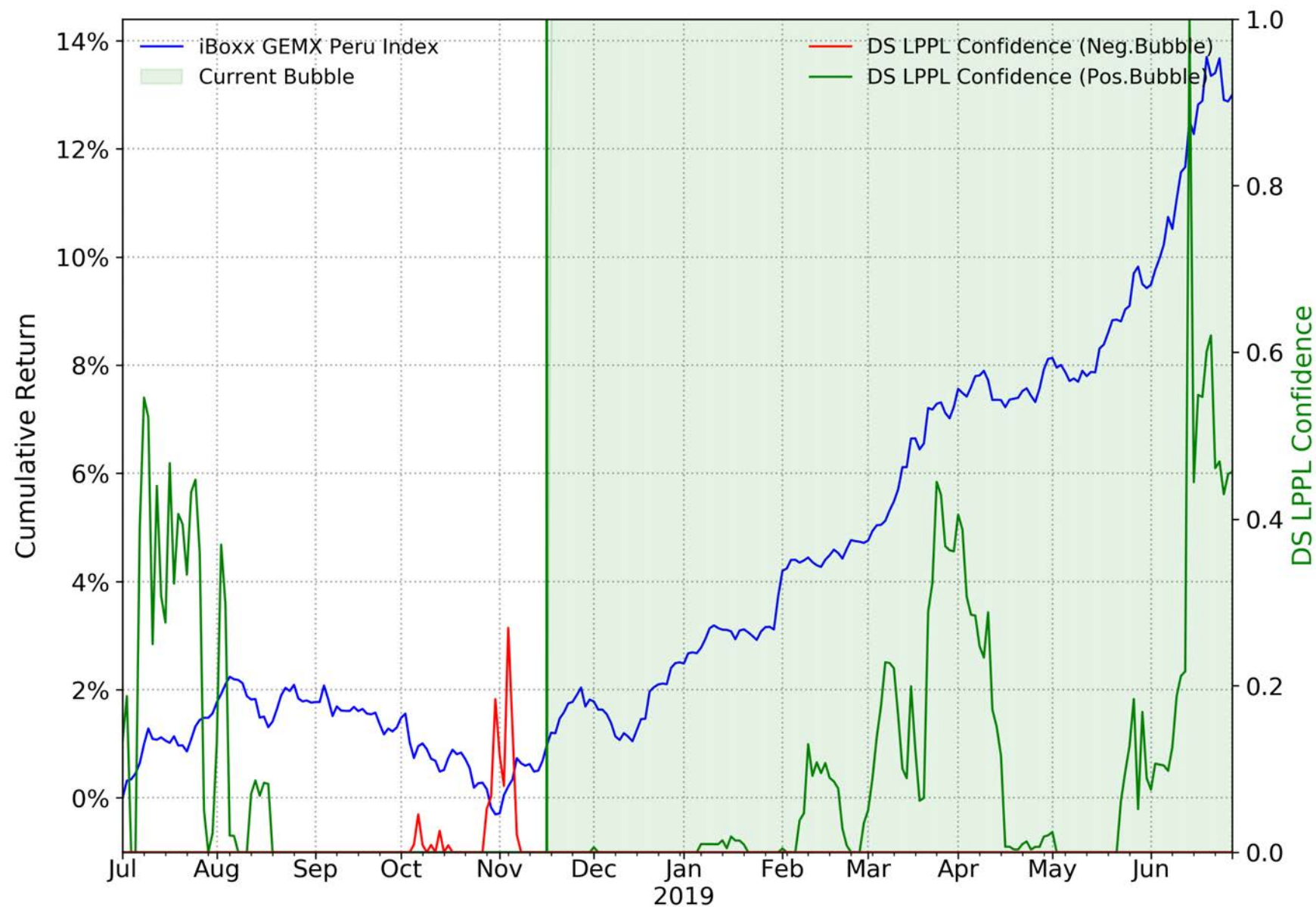
# Fixed Income – Government Bond Indices

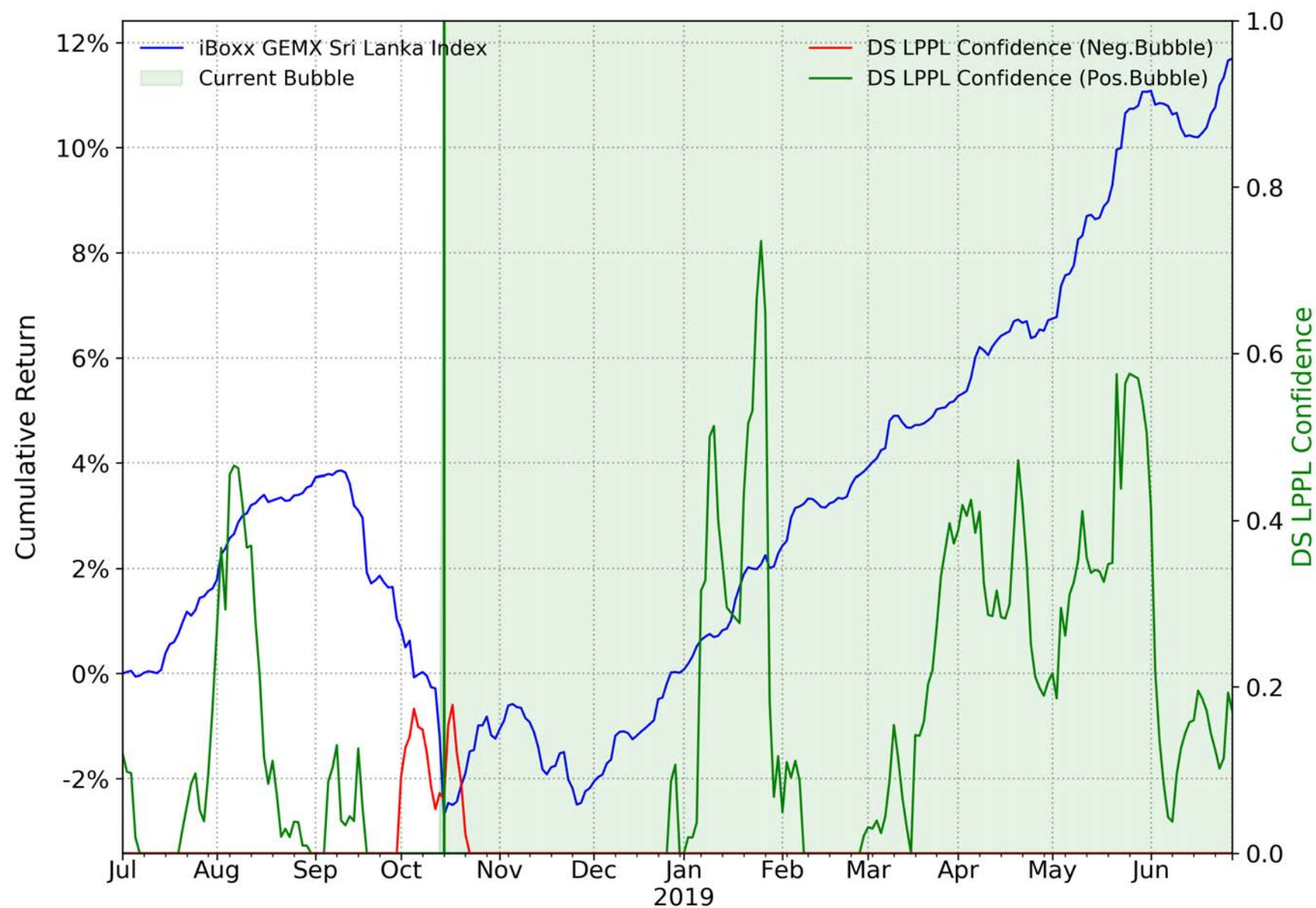
Bubble Data					Cluster Analysis				
	Name	Bubble Size $bs$ [%]	Duration [ $days$ ]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [ $days$ ]	Scenario Probability [%]	
Positive Bubbles									
1	iBoxx GEMX Mexico 10+ Index	21	225	28		24	2019-07-01	2	63
2	iBoxx GEMX Peru Index	12	224	46		23	2019-07-05	6	65
3	iBoxx GEMX Sri Lanka Index	15	258	17		16	2019-07-03	5	37
4	iBoxx Asia Philippines Index	22	258	11		16	2019-07-04	5	56
5	iBoxx Asia Philippines Government Index	22	258	11		16	2019-07-04	5	56

We find several new positive bubble signals for various indices, amongst which the Sri Lanka index appears yet again. The corresponding plots of the DS LPPL Confidence Indicator for some of these indices are depicted on the following slides.









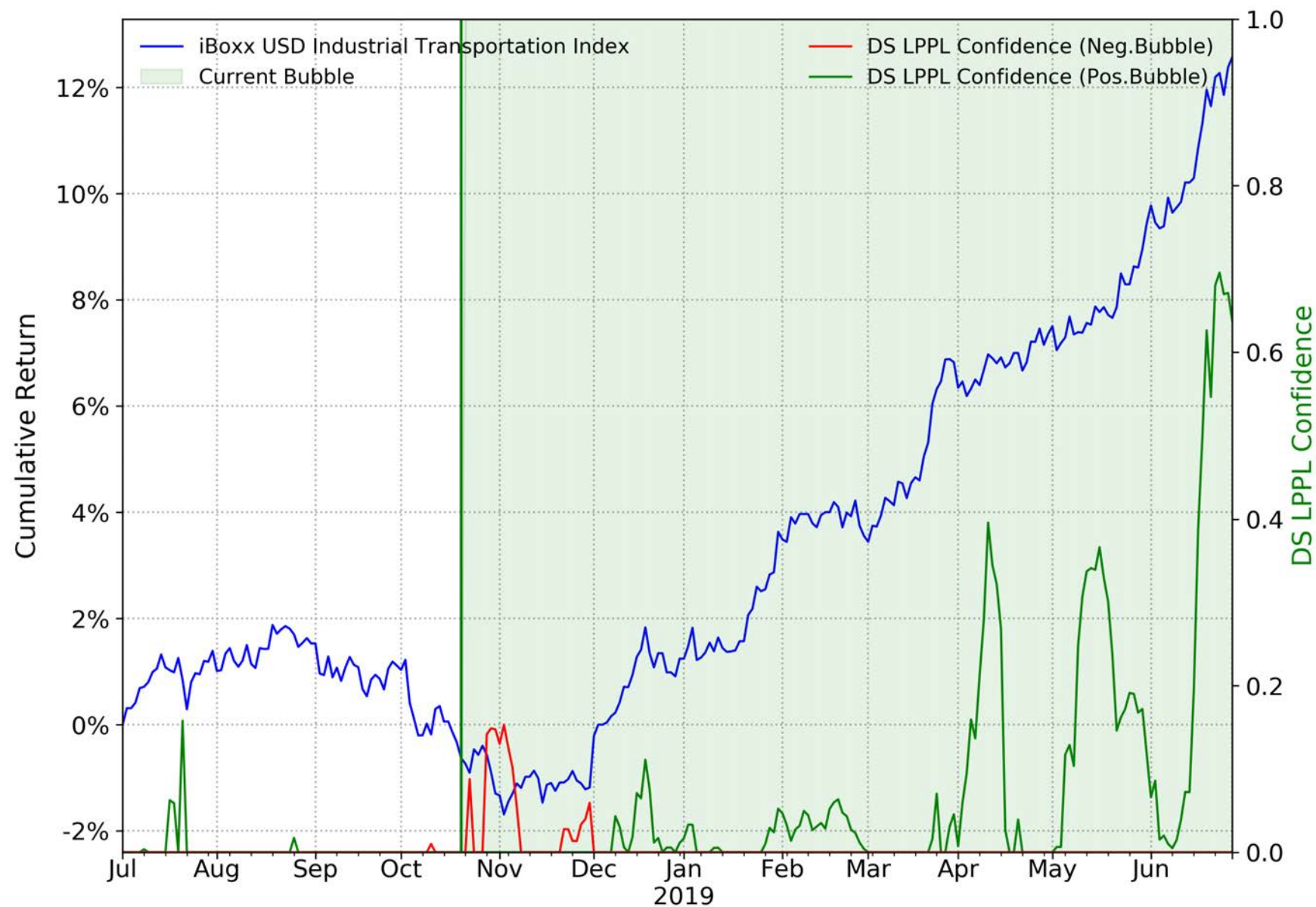
# Fixed Income – Corporate Bonds

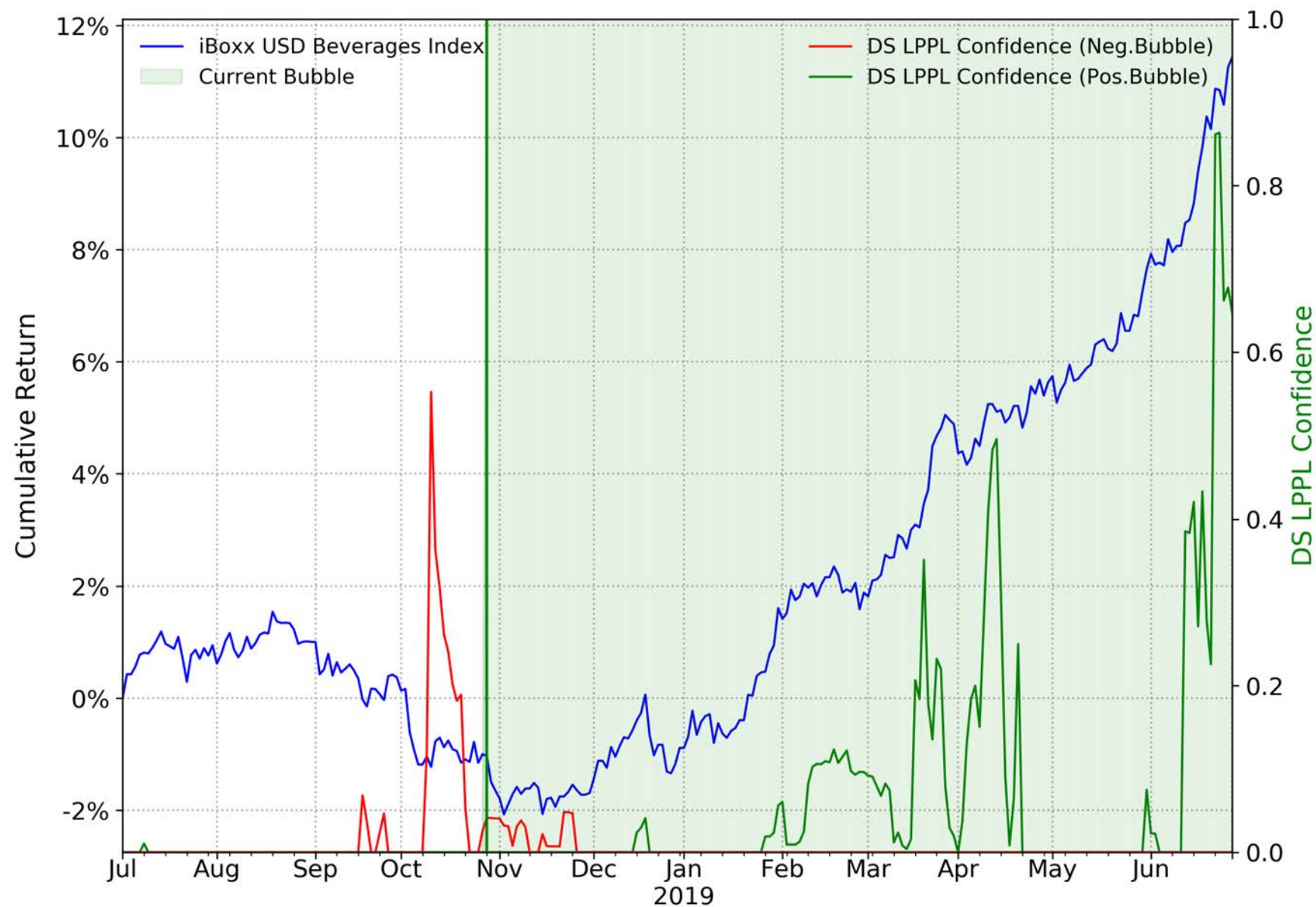
Bubble Data					Cluster Analysis			
	Name	Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [days ]	Scenario Probability [%]
<b>Positive Bubbles</b>								
1	iBoxx USD Industrial Transportation Index	13	252	64	29	2019-07-05	6	70
2	iBoxx USD Personal Goods Index	11	267	74	29	2019-07-02	3	84
3	iBoxx USD Beverages Index	13	244	65	29	2019-07-05	5	56
4	iBoxx USD General Industrials Index	12	230	69	28	2019-07-09	9	74
5	iBoxx USD Nonlife Insurance Index	13	240	60	28	2019-07-09	10	78

Turning to corporate bond indices, we detect several new positive bubble signals. The detected bubble sizes are around 11-13%, bubble durations range from 240-267 days, so approximately 8-9 months. The similarity of the estimated bubble characteristics, as well as the confidence indicator level (60-74%), indicates that these bubble signals may originate from the same source [\*], as they evolved on the same scale and with the same intensity. Furthermore, the predicted mean critical times of the biggest computed fit clusters are also quite coincident. Their values indicate a potential regime change that is expected in the near future.

[\*] the plateauing of the target range for the Fed Fund rate at 2.25-2.5% since 19 Dec. 2019)



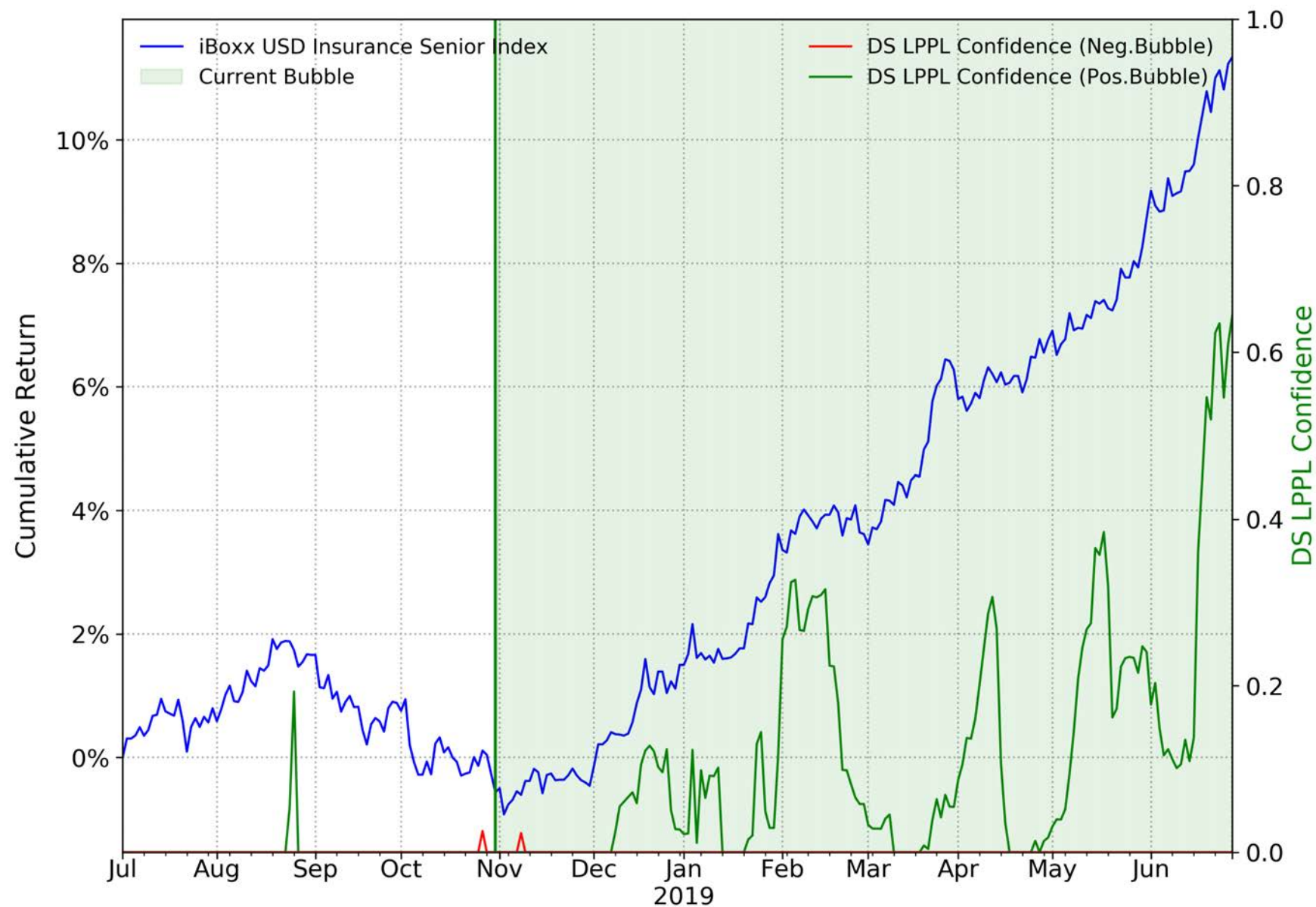




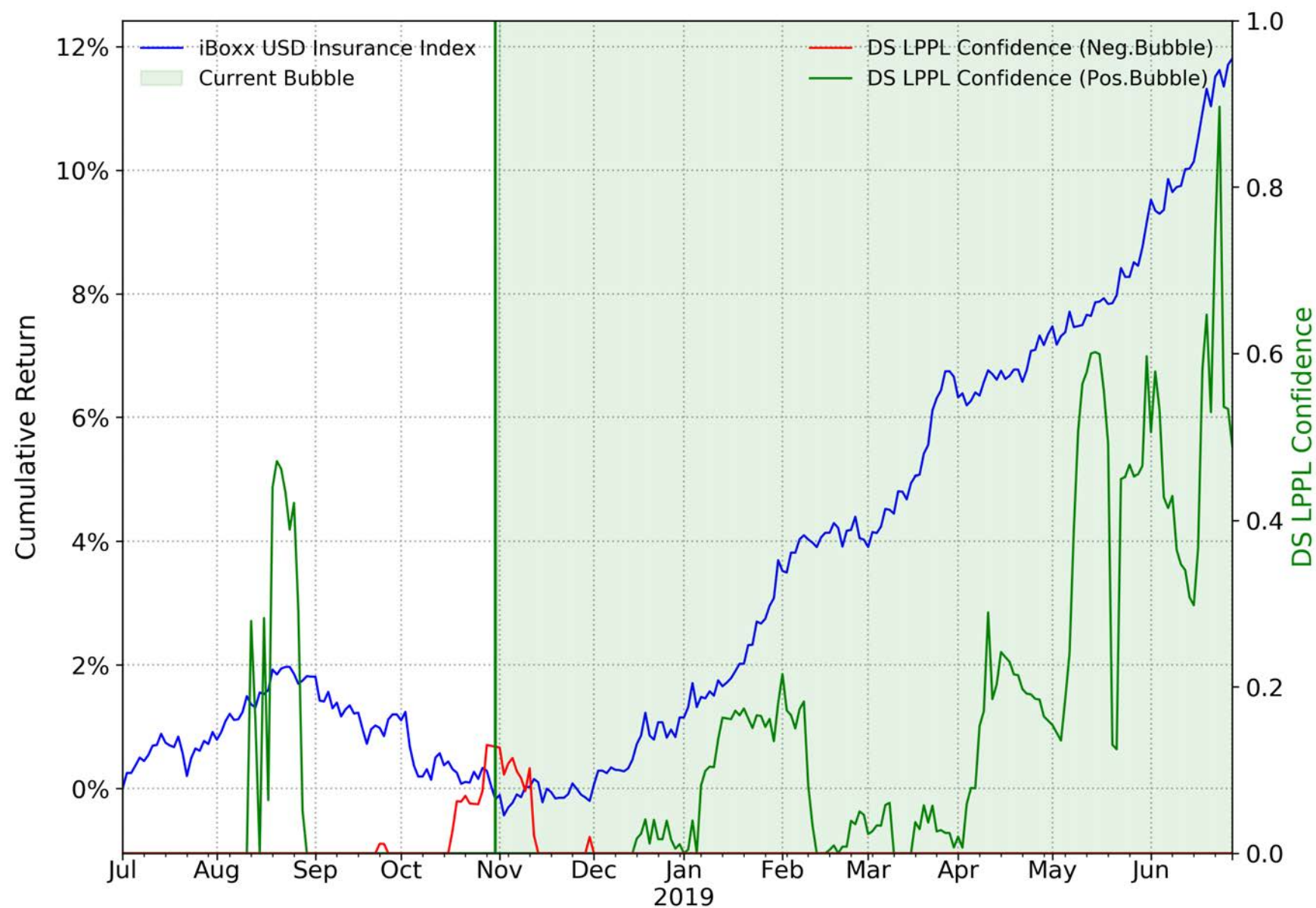
# Fixed Income – Financial & Insurance

Bubble Data					Cluster Analysis			
	Name	Bubble Size $bs$ [%]	Duration [ $days$ ]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$	Scenario Probability [%]
							[ $days$ ]	
Positive Bubbles								
1	iBoxx USD Insurance Senior Index	12	240	64	28	2019-07-06	8	85
2	iBoxx USD Insurance Index	12	240	49	24	2019-07-10	10	74

As we regard financial and insurance bonds as an important branch amongst the corporate bond index class to study on its own, here we separately list the obtained signals for this sector. As can be seen, both detected bubble signals refer to insurance indices. The bubble characteristics exactly coincide, which is expected, as the two time series of the indices are strongly positively correlated. One may ask whether it is sufficient to regard just one of these assets, but we find it reasonable to observe even strongly correlated time series, as essentially this helps ‘averaging out’ market noise.



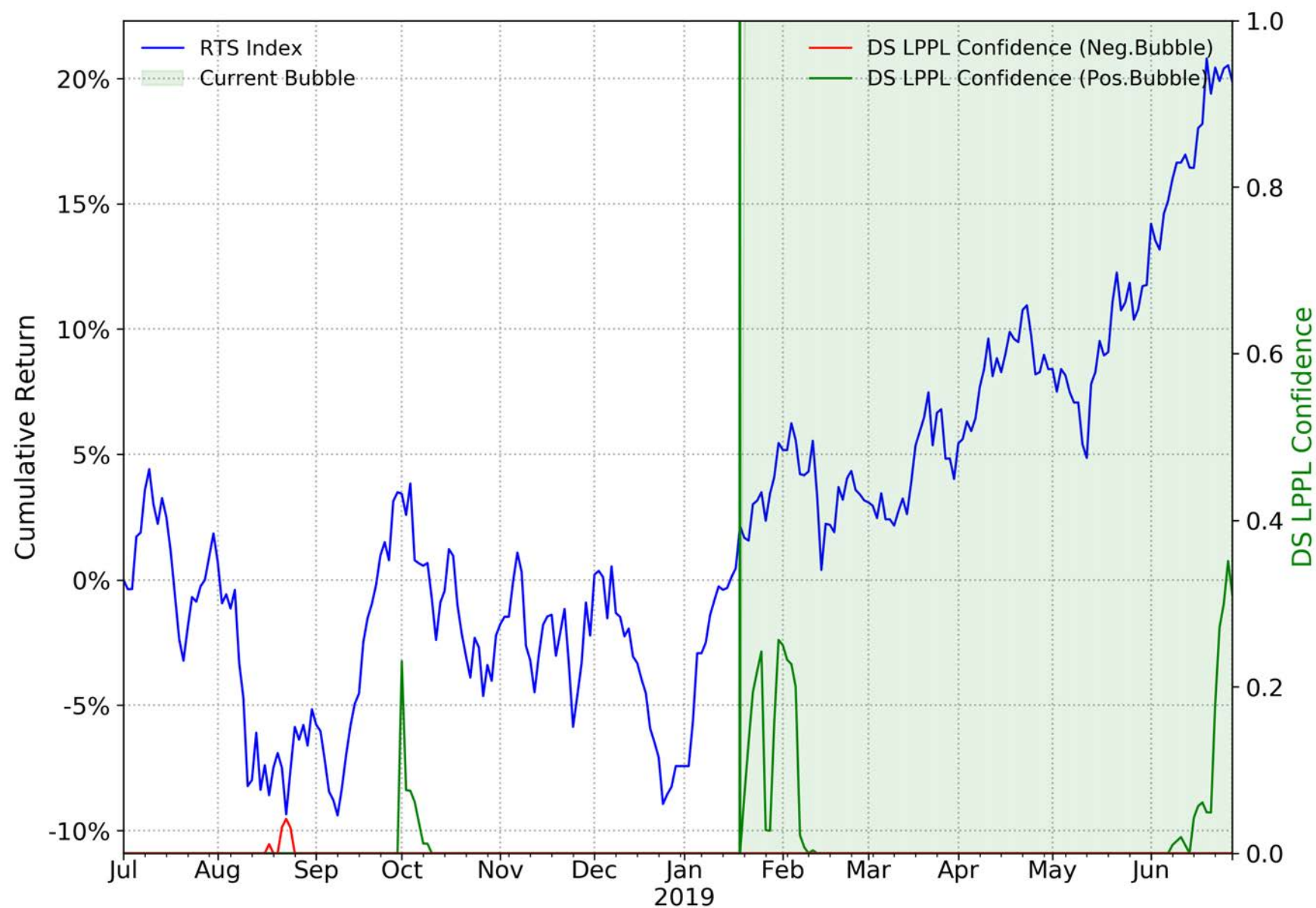


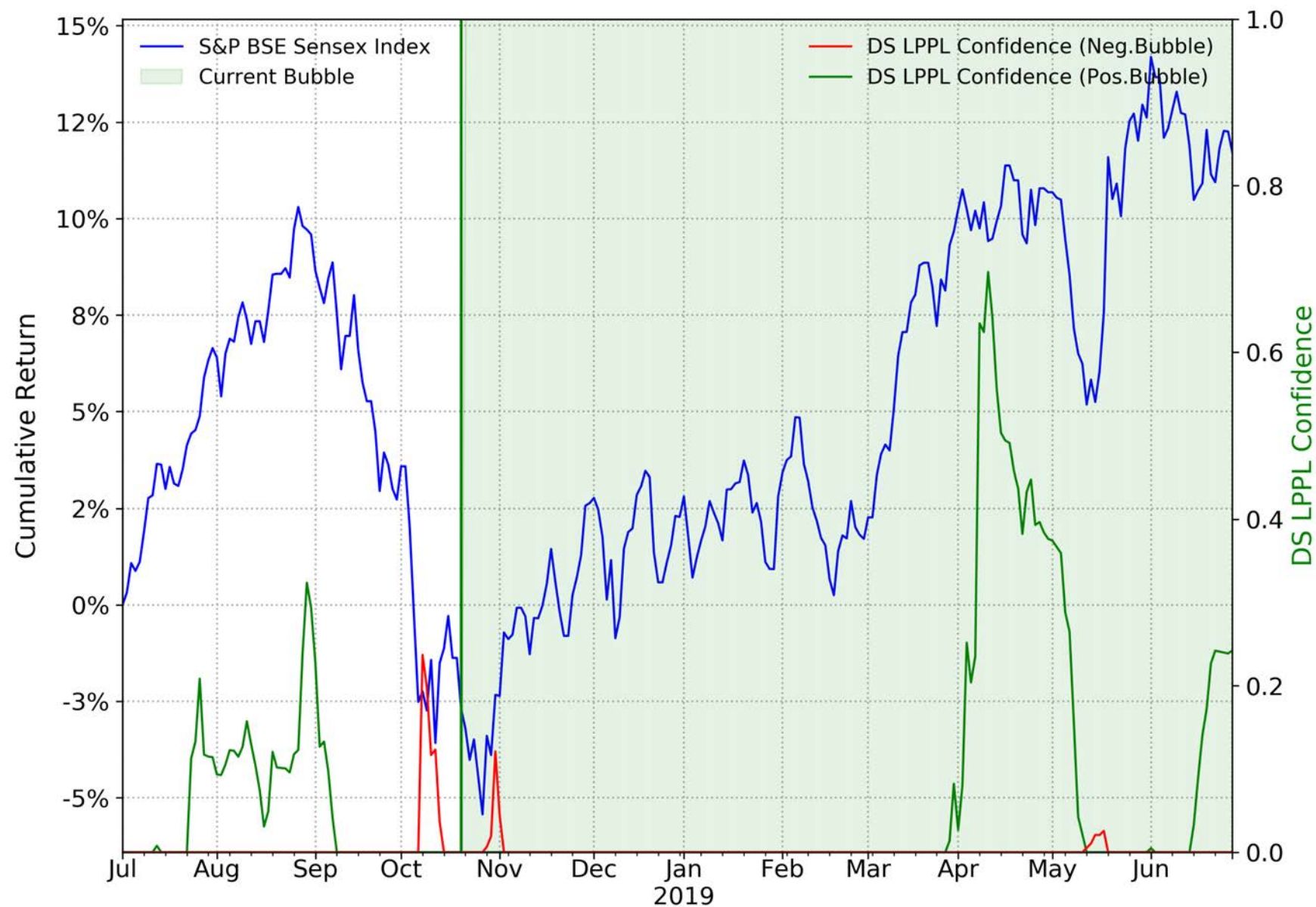


# Equity – Country Indices

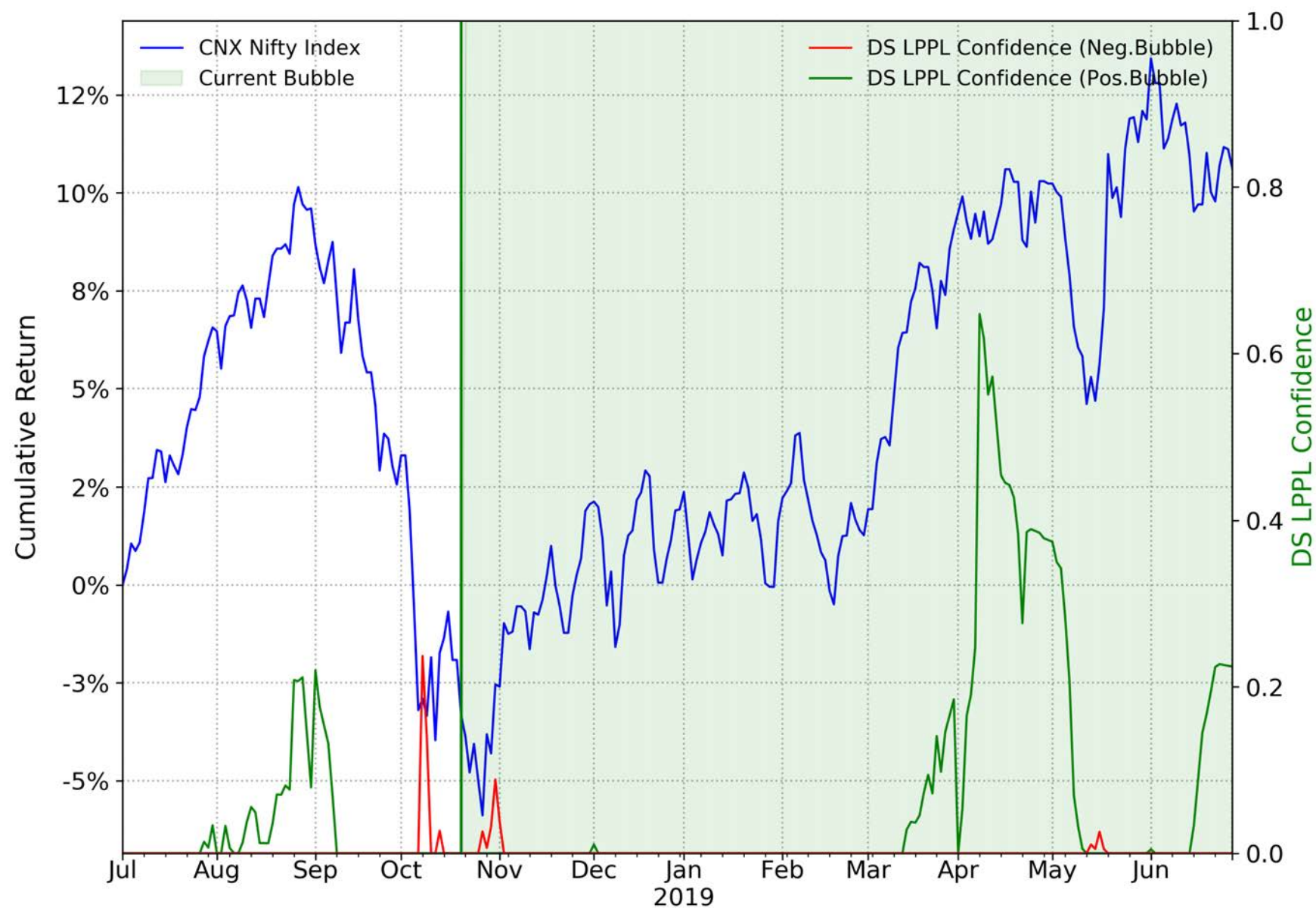
Bubble Data					Cluster Analysis			
Name		Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{t_c}$	$\sigma_{t_c}$ [days]	Scenario Probability [%]
Positive Bubbles								
1	RTS Index	17	161	31	23	2019-07-07	1	25
2	S&P BSE Sensex Index	15	252	24	19	2019-08-05	2	11
3	CNX Nifty Index	14	252	22	18	2019-08-10	4	35

Regarding stock indices for different countries, we find three positive bubble signals at the beginning of July, the Russian RTS, the Indian BSE Sensex, as well as the larger Indian CNX Nifty. Unsurprisingly, again, for the two correlated Indian indices, we find similar characteristics. The largest bubbles size at the shortest duration however is detected on the Russian RTS, which indicates that it has undergone the strongest growth per unit time. For all indices, the indicator levels are still fairly low, but the further development of the situation should be carefully monitored.





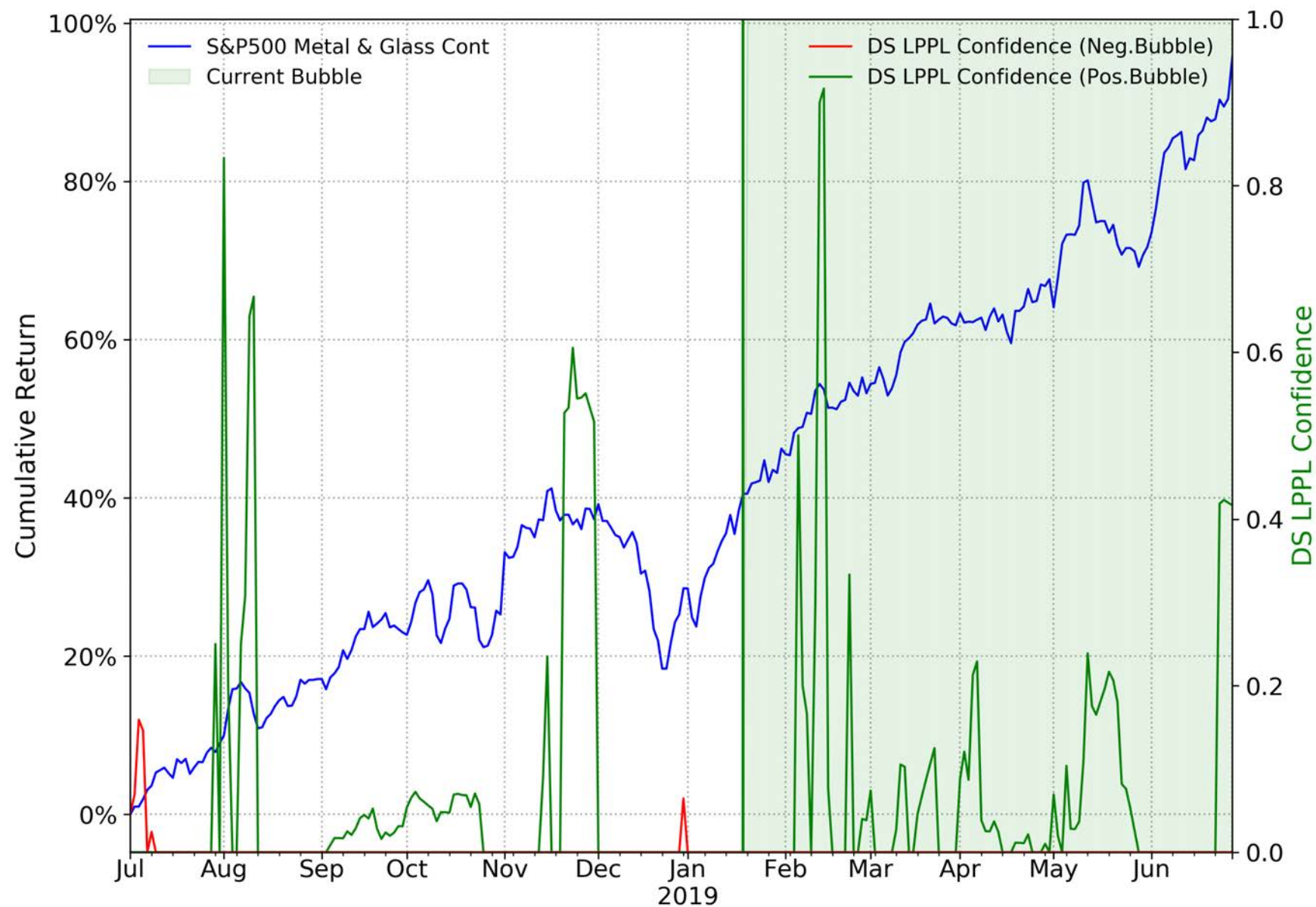


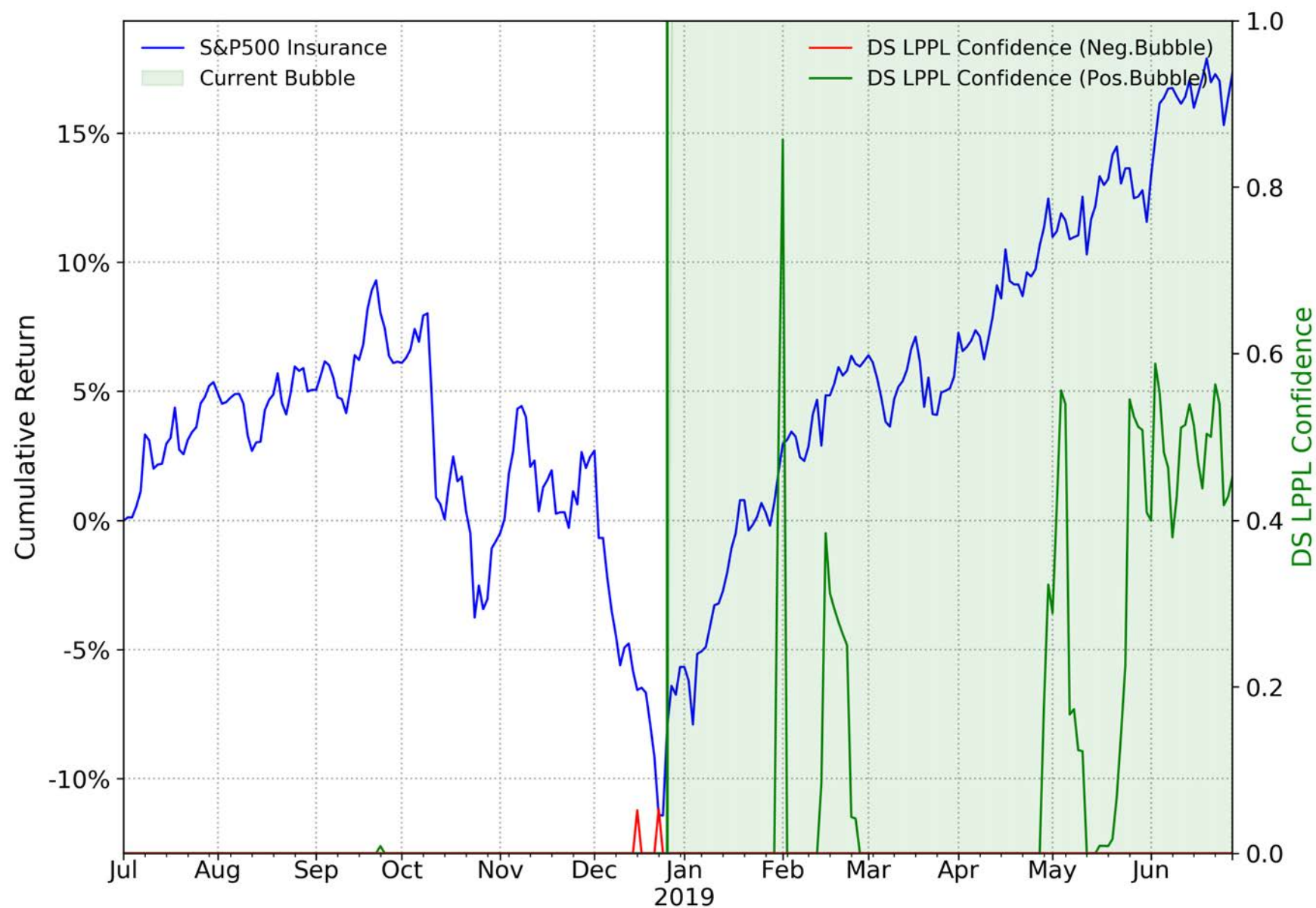


# Equity – US Indices

Bubble Data					Cluster Analysis			
	Name	Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [days ]	Scenario Probability [%]
Positive Bubbles								
1	S&P500 Metal & Glass Cont	39	161	42	40	2019-07-04	1	40
2	S&P500 Insurance	27	184	45	35	2019-07-31	4	43
3	S&P500 Insurance In	27	184	45	35	2019-07-31	4	43
4	S&P500 Personal Products Si	21	140	50	33	2019-06-28		46
5	S&P500 Personal Products	21	140	50	33	2019-06-28		46

Amongst United States S&P500 sub-indices, we find signals in insurance indices, which should be put in perspective with the previously mentioned findings in USD insurance bond indices. For the insurance sector equity indices considered here, the detected bubble size of 27% is larger (compared to 12% in fixed income) at a shorter bubble duration of 184 days, compared to 240 days. This more intense growth is expectable, due to the fact that usually the movements of equities indices are stronger than for their counterparts in the ‘more conservative’ fixed income class.







# Commodities

Bubble Data				Cluster Analysis			
Name	Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [days ]	Scenario Probability [%]
Positive Bubbles							
Wheat ER Index	18	113	31	24	2019-06-28		39

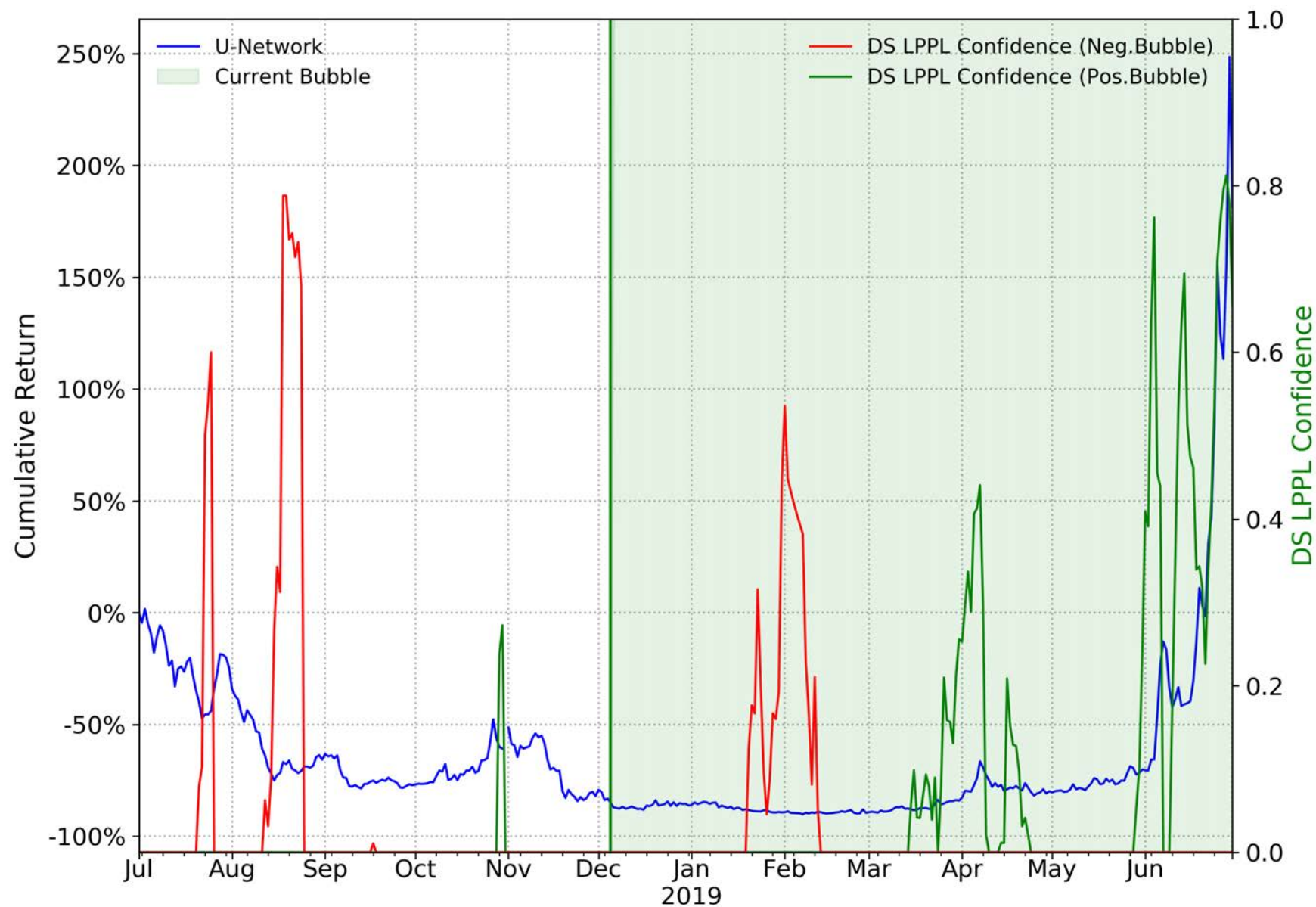
A relatively strong bubble at a however fairly low confidence indicator level is detected for wheat. The indicator plot for the commodity is depicted on the following slide.



# Cryptocurrencies

Bubble Data					Cluster Analysis			
	Name	Bubble Size $bs$ [%]	Duration $[days]$	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{t_c}$	$\sigma_{t_c}$ $[days]$	Scenario Probability [%]
Positive Bubbles								
1	U-Network	1778	207	66	342	2019-07-03	2	74
2	Ren	346	222	61	145	2019-07-04		23
3	Republic-Protocol	346	222	54	137	2019-07-04	4	92
4	Chainlink	699	123	24	131	2019-07-10	1	73
5	Tether	103	242	81	91	2019-06-30	1	85
Negative Bubbles								
1	Ripple	-25	281	19	22	2019-07-16	12	87

In the cryptocurrency sector, the prevailing trend of strong bubble activity continues. The strongest positive bubble signal is found for U-Network, a coin currently capitalized with less than 35M USD, according to coinmarketcap.com. Clearly, this coin has undergone an extreme surge lately and there will be a crash on this coin in the near future.





# Single Stocks

For 826 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.

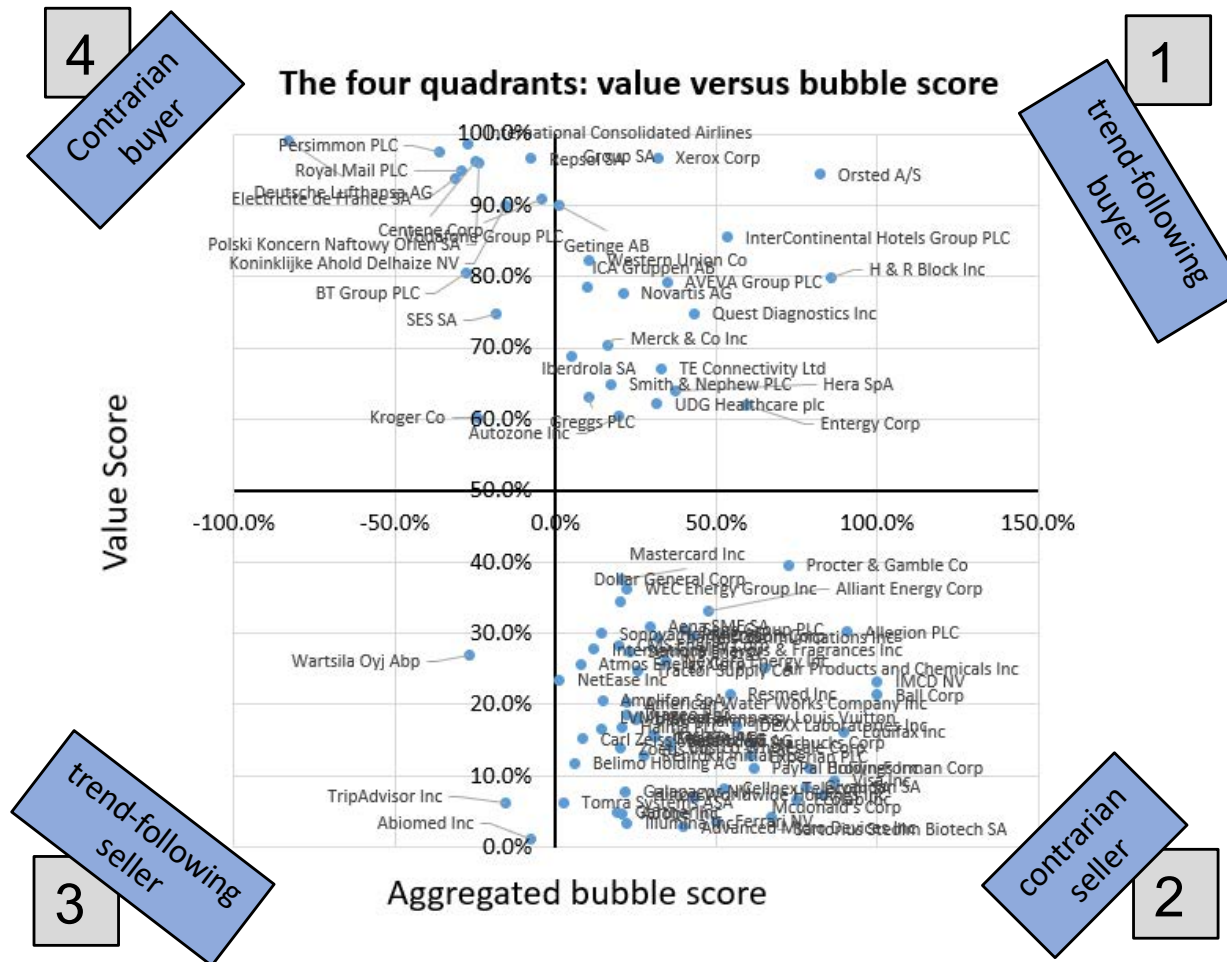


# List of Indicators

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



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. H&R Blocks Inc);
2. [Quadrant 2](#): Stocks with a strong positive bubble score and a weak value score (e.g. Alliant Energy Corp);
3. [Quadrant 3](#): Stocks with a strong negative bubble score and a weak value score (e.g. Abiomed Inc);
4. [Quadrant 4](#): Stocks with strong negative bubble score and a strong financial strength (e.g. SES SA)

\*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%.



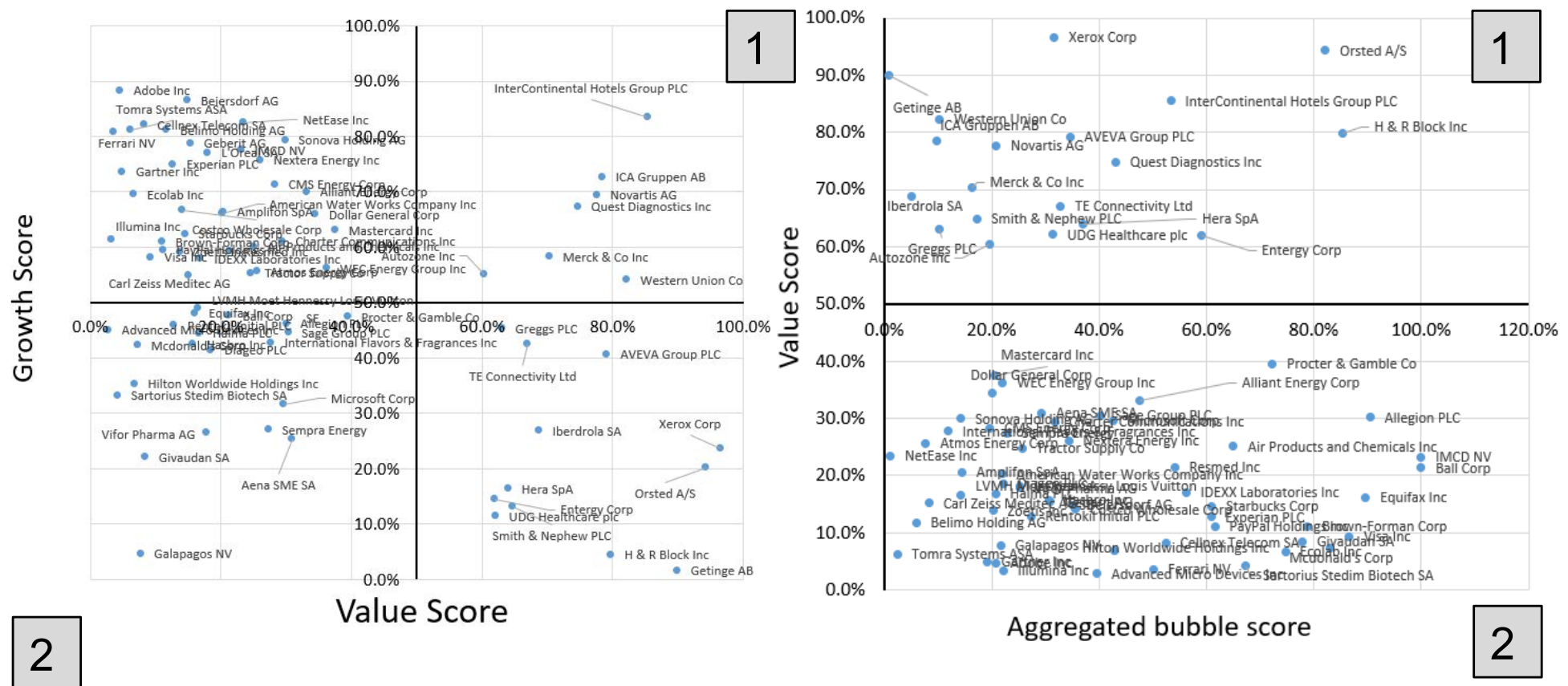
Each quadrant has its own specs:

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)

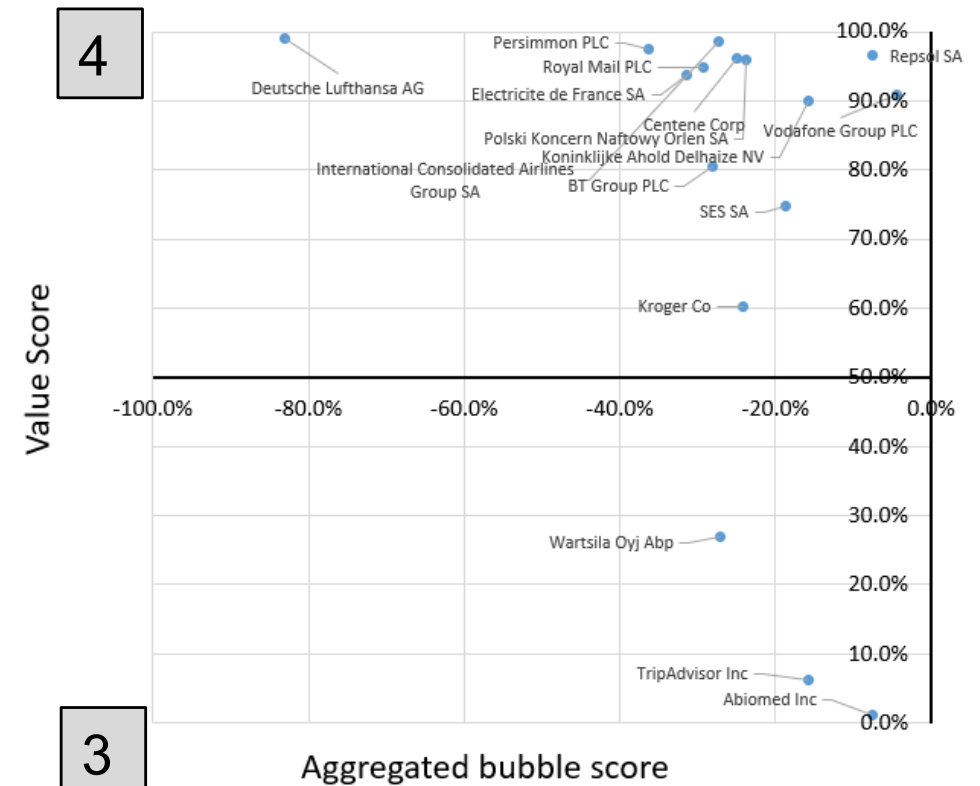
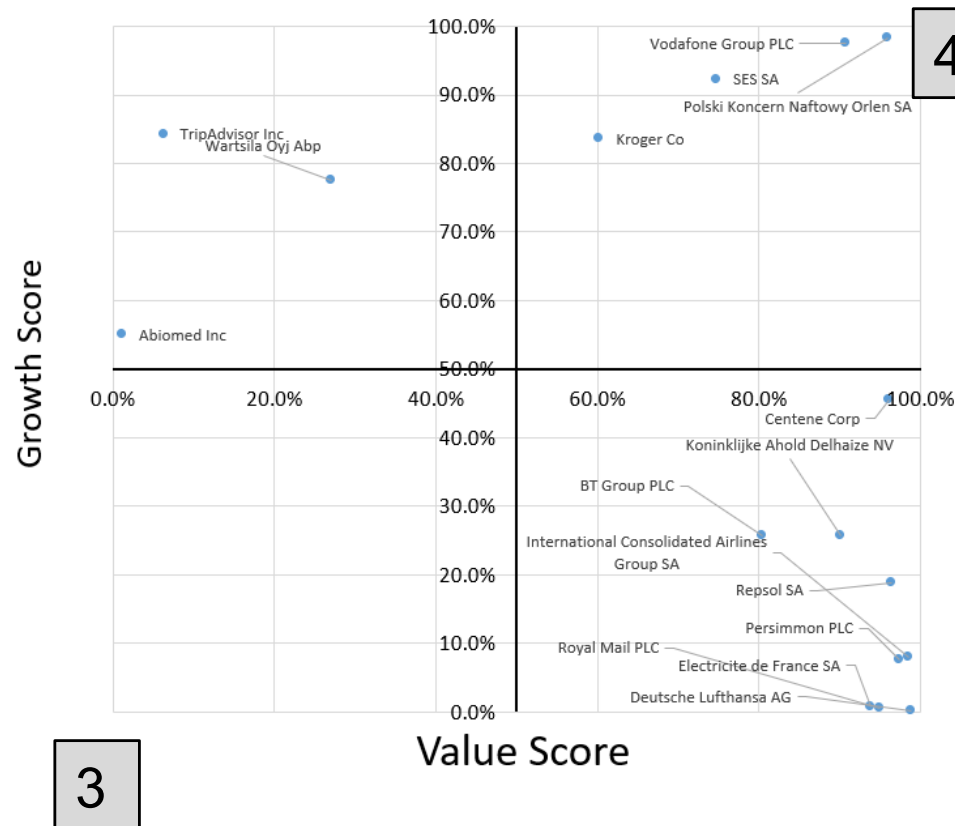
Strong positive bubble signals with strong (respectively weak) fundamentals



# Single Stocks

## Quadrants 3 and 4 (stocks)

Strong negative bubble signals with weak (respectively strong) fundamentals



# Single Stocks

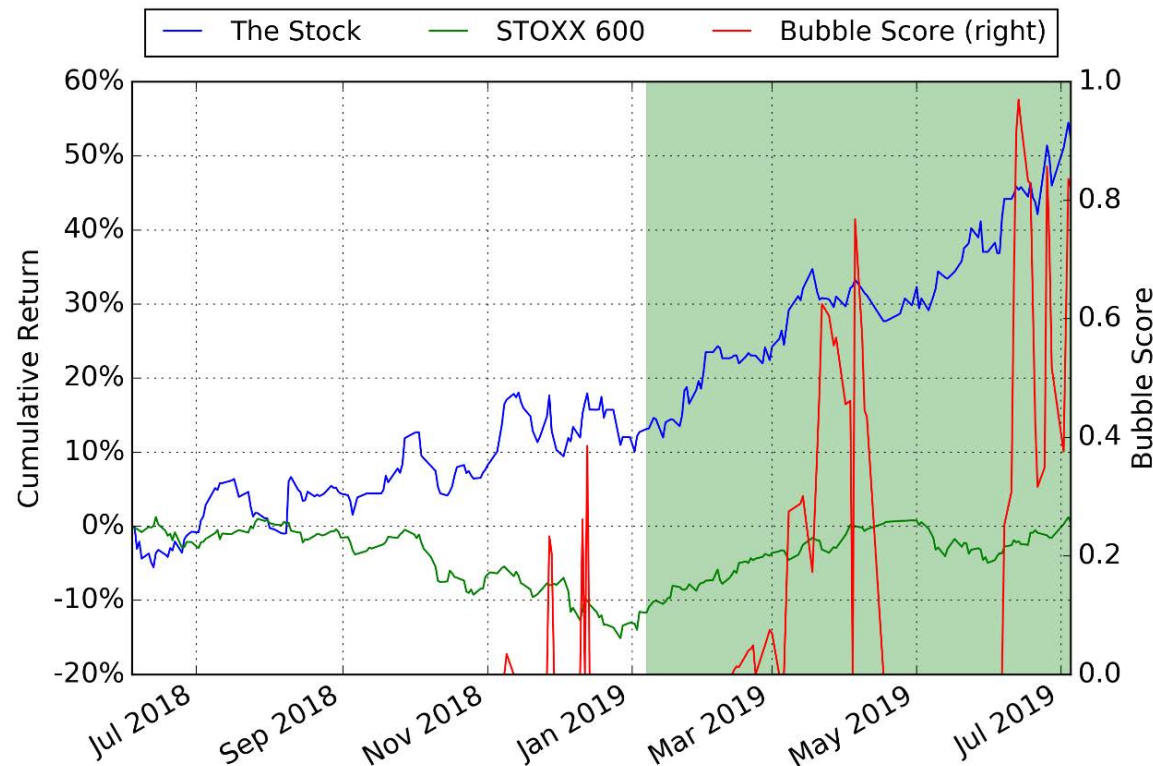
## Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Novartis AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	29.1%	24.1%	Aug-18	20.9%	77.6%	69.4%
TE Connectivity Ltd	Switzerland	Technology Hardware & Equipment	4.5%	21.3%	Oct-18	32.9%	67.1%	42.5%
Orsted A/S	Denmark	Utilities	43.5%	24.2%	Feb-19	82.2%	94.3%	20.2%
Iberdrola SA	Spain	Utilities	35.1%	41.9%	Sep-18	5.1%	68.8%	26.8%
Smith & Nephew PLC	United Kingdom	Health Care Equipment & Services	29.0%	29.0%	Jul-18	17.3%	64.8%	13.2%
Greggs PLC	United Kingdom	Consumer Services	147.8%	110.5%	Oct-18	10.2%	63.1%	45.3%
AVEVA Group PLC	United Kingdom	Software & Services	45.2%	50.5%	Oct-18	34.6%	79.2%	40.6%
InterContinental Hotels Group PLC	United Kingdom	Consumer Services	9.1%	30.4%	Oct-18	53.4%	85.5%	83.4%
UDG Healthcare plc	Ireland; Republic of	Health Care Equipment & Services	-6.9%	35.3%	Jan-19	31.4%	62.1%	11.4%
Hera SpA	Italy	Utilities	26.8%	18.4%	Jan-19	37.1%	64.0%	16.3%
Getinge AB	Sweden	Health Care Equipment & Services	66.9%	75.0%	Nov-18	0.9%	90.0%	1.6%
ICA Gruppen AB	Sweden	Food & Staples Retailing	42.0%	26.1%	Jan-19	9.7%	78.5%	72.6%
Autozone Inc	United States of America	Retailing	63.2%	28.4%	Dec-18	19.6%	60.4%	55.1%
H & R Block Inc	United States of America	Consumer Services	20.1%	16.1%	Dec-18	85.5%	79.8%	4.4%
Entergy Corp	United States of America	Utilities	27.5%	30.1%	Sep-18	59.2%	62.0%	14.5%
Merck & Co Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	36.8%	27.1%	Aug-18	16.4%	70.3%	58.2%
Quest Diagnostics Inc	United States of America	Health Care Equipment & Services	-9.7%	25.8%	Dec-18	43.1%	74.7%	67.3%
Western Union Co	United States of America	Software & Services	0.4%	9.4%	43374	10.3%	82.2%	54.0%
Xerox Corp	United States of America	Technology Hardware & Equipment	45.9%	29.4%	43466	31.7%	96.6%	23.6%

# Single Stocks - Quadrant 1 stocks

**Quadrant 1 stocks:** strong positive bubble signals with strong fundamentals

Example: Orsted A/S.

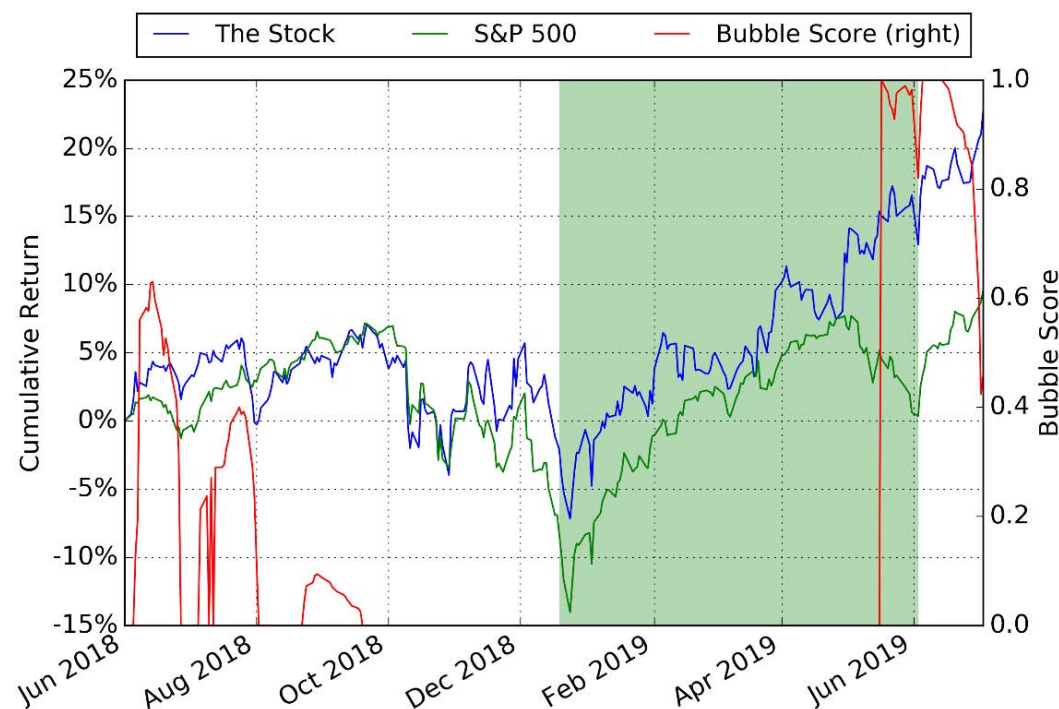


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this six month bubble has reached 82.2% with a bubble size 24.2%.

# Single Stocks - Quadrant 1 stocks

**Last month example:** strong positive bubble signals with strong fundamentals, Fidelity National Information Services Inc.

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 continued to draw up in the past month, which is in agreement with the strong fundamentals, and with the nonlinear strong positive momentum indicator associated with our DS LPPLS indicator.





# 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
Galapagos NV	Belgium	Pharmaceuticals, Biotechnology & Life Sciences	39.8%	44.0%	Jan-19	21.7%	7.7%	4.6%
Belimo Holding AG	Switzerland	Capital Goods	41.8%	24.7%	Aug-18	6.0%	11.7%	81.1%
Givaudan SA	Switzerland	Materials	14.8%	13.5%	Jan-19	77.9%	8.5%	22.0%
Sonova Holding AG	Switzerland	Health Care Equipment & Services	19.6%	19.6%	Jul-18	14.3%	29.9%	79.3%
Geberit AG	Switzerland	Capital Goods	5.0%	19.4%	Nov-18	31.0%	15.4%	78.7%
Vifor Pharma AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	-21.0%	14.4%	Jan-19	25.2%	17.8%	26.5%
Beiersdorf AG	Germany	Household & Personal Products	8.3%	25.5%	Jan-19	35.1%	14.9%	86.4%
Carl Zeiss Meditec AG	Germany	Health Care Equipment & Services	33.0%	24.4%	Oct-18	8.3%	15.1%	54.8%
Aena SME SA	Spain	Transportation	11.6%	17.4%	Sep-18	29.3%	31.0%	25.3%
Cellnex Telecom SA	Spain	Telecommunication Services	55.1%	57.5%	Dec-18	52.4%	8.2%	82.1%
L'Oreal SA	France	Household & Personal Products	20.5%	20.5%	Jul-18	25.3%	18.0%	77.0%
LVMH Moët Hennessy Louis Vuitton SE	France	Consumer Durables & Apparel	30.0%	37.2%	Jan-19	14.3%	16.6%	48.9%
Sartorius Stedim Biotech SA	France	Pharmaceuticals, Biotechnology & Life Sciences	44.3%	32.2%	Jan-19	67.2%	4.2%	33.2%
Diageo PLC	United Kingdom	Food, Beverage & Tobacco	23.7%	24.6%	Aug-18	22.1%	18.5%	41.4%
Halma PLC	United Kingdom	Technology Hardware & Equipment	47.3%	47.3%	Jul-18	20.7%	16.7%	44.4%
Rentokil Initial PLC	United Kingdom	Commercial & Professional Services	17.5%	35.1%	Oct-18	27.3%	12.8%	45.9%
Experian PLC	Ireland; Republic of	Commercial & Professional Services	24.6%	27.8%	Jan-19	60.8%	12.7%	74.9%
Sage Group PLC	United Kingdom	Software & Services	30.0%	39.7%	Sep-18	40.3%	30.4%	44.6%
Allegion PLC	Ireland; Republic of	Capital Goods	40.1%	38.0%	Dec-18	90.5%	30.1%	46.1%
Amplifon SpA	Italy	Health Care Equipment & Services	20.3%	31.5%	Jan-19	14.5%	20.5%	66.3%
IMCD NV	Netherlands	Capital Goods	26.8%	26.2%	Jan-19	100.0%	23.1%	77.5%
Ferrari NV	Italy	Automobiles & Components	22.1%	42.7%	Oct-18	50.2%	3.6%	80.8%
Tomra Systems ASA	Norway	Commercial & Professional Services	60.5%	41.5%	Oct-18	2.5%	6.2%	81.2%
Adobe Inc	United States of America	Software & Services	19.4%	19.3%	Feb-19	20.8%	4.6%	88.3%
Advanced Micro Devices Inc	United States of America	Semiconductors & Semiconductor Equipment	90.0%	36.4%	Jan-19	39.6%	2.8%	45.0%
Air Products and Chemicals Inc	United States of America	Materials	48.2%	50.4%	Oct-18	65.0%	25.1%	60.0%
Alliant Energy Corp	United States of America	Utilities	16.8%	18.3%	Sep-18	47.7%	33.2%	70.0%
American Water Works Company Inc	United States of America	Utilities	34.7%	31.2%	Oct-18	21.9%	20.2%	66.1%
Atmos Energy Corp	United States of America	Utilities	17.6%	10.8%	Nov-18	7.7%	25.5%	55.6%

# Single Stocks - Quadrant 2 stocks

## Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

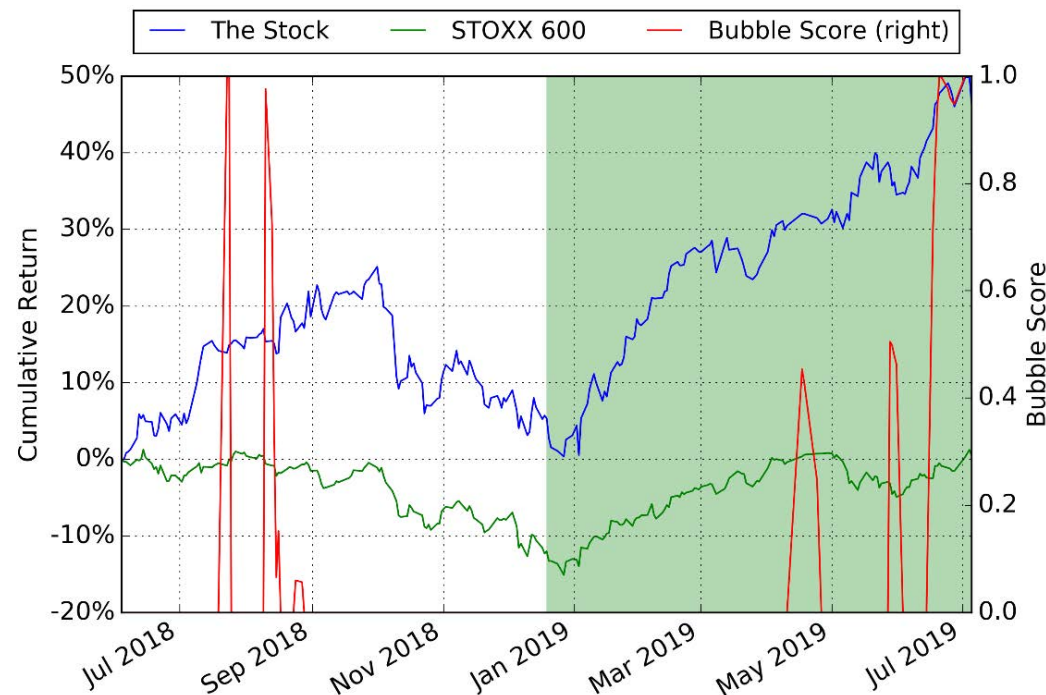
Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Ball Corp	United States of America	Materials	91.8%	35.4%	Feb-19	100.0%	21.3%	47.6%
Brown-Forman Corp	United States of America	Food, Beverage & Tobacco	11.7%	21.0%	Jan-19	78.8%	11.0%	60.9%
CMS Energy Corp	United States of America	Utilities	23.1%	15.1%	Nov-18	19.7%	28.3%	71.3%
Charter Communications Inc	United States of America	Media & Entertainment	32.0%	38.0%	Jul-18	31.7%	29.4%	61.0%
Costco Wholesale Corp	United States of America	Food & Staples Retailing	24.9%	24.9%	Jul-18	35.6%	14.0%	66.7%
Dollar General Corp	United States of America	Retailing	41.2%	25.2%	Nov-18	20.0%	34.5%	65.9%
Ecolab Inc	United States of America	Materials	38.2%	38.0%	Dec-18	74.7%	6.7%	69.5%
Equifax Inc	United States of America	Commercial & Professional Services	9.0%	32.4%	Jan-19	89.7%	16.1%	48.1%
Gartner Inc	United States of America	Software & Services	21.0%	30.9%	Dec-18	19.1%	5.0%	73.6%
Hasbro Inc	United States of America	Consumer Durables & Apparel	13.3%	32.8%	Dec-18	30.6%	15.7%	42.4%
Hilton Worldwide Holdings Inc	United States of America	Consumer Services	25.6%	25.6%	Jul-18	43.0%	6.8%	35.2%
IDEXX Laboratories Inc	United States of America	Health Care Equipment & Services	17.1%	41.6%	Nov-18	56.2%	16.9%	57.9%
Illumina Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	25.2%	28.9%	Dec-18	22.2%	3.3%	61.3%
International Flavors & Fragrances Inc	United States of America	Materials	13.9%	9.4%	Feb-19	11.9%	27.7%	42.7%
Mastercard Inc	United States of America	Software & Services	33.3%	33.3%	Jul-18	20.6%	37.5%	63.0%
Mcdonald's Corp	United States of America	Consumer Services	33.0%	18.5%	Jan-19	83.1%	7.3%	42.3%
Microsoft Corp	United States of America	Software & Services	30.6%	34.5%	Jan-19	42.5%	29.7%	31.6%
NetEase Inc	China	Media & Entertainment	-2.5%	21.2%	Aug-18	1.2%	23.5%	82.4%
Nextera Energy Inc	United States of America	Utilities	22.8%	23.3%	Sep-18	34.3%	26.0%	75.7%
PayPal Holdings Inc	United States of America	Software & Services	33.5%	32.1%	Jan-19	61.6%	11.1%	59.4%
Procter & Gamble Co	United States of America	Household & Personal Products	42.3%	17.3%	Jan-19	72.3%	39.5%	47.3%
Resmed Inc	United States of America	Health Care Equipment & Services	14.1%	31.5%	Jan-19	54.1%	21.4%	59.2%
Sempra Energy	United States of America	Utilities	19.5%	22.9%	43405	22.9%	27.4%	27.0%
Starbucks Corp	United States of America	Consumer Services	72.3%	26.6%	43497	61.0%	14.5%	62.3%
Tractor Supply Co	United States of America	Retailing	40.9%	40.9%	43282	25.6%	24.7%	55.3%
Visa Inc	United States of America	Software & Services	27.6%	32.2%	43466	86.6%	9.3%	58.1%
WEC Energy Group Inc	United States of America	Utilities	30.7%	19.9%	43405	22.0%	36.2%	56.2%
Zoetis Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	35.0%	27.3%	43313	20.3%	13.8%	59.1%



# Single Stocks - Quadrant 2 stocks

**Quadrant 2 stocks:** strong positive bubble signals with weak fundamentals

Example: IMCD NV.

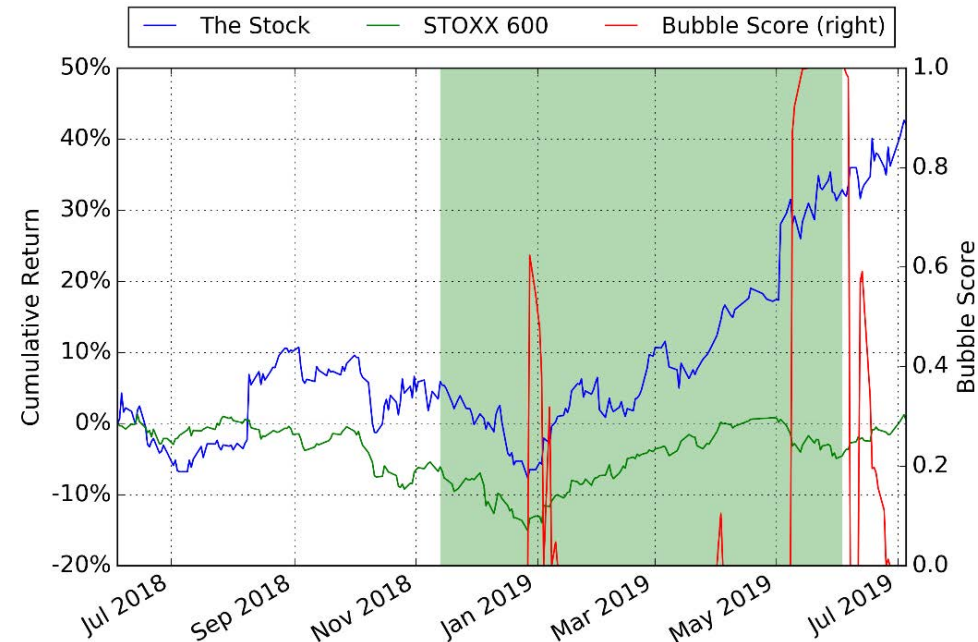


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the positive bubble we identified. The Bubble Score of this six month bubble has reached 100% with a bubble size 26.2%. The strong positive bubble signals and weak fundamentals indicate a high probability of correction in the future.

# Single Stocks - Quadrant 2 stocks

**Last month example:** strong positive bubble signals with weak fundamentals, Adidas AG.

The figure below plots the one year cumulative return of the stock (blue), STOXX 600 (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 continued to increase in the past month, which is in contradiction with the weak fundamentals and our DS LPPLS indicator.



# Single Stocks - Quadrant 3 stocks

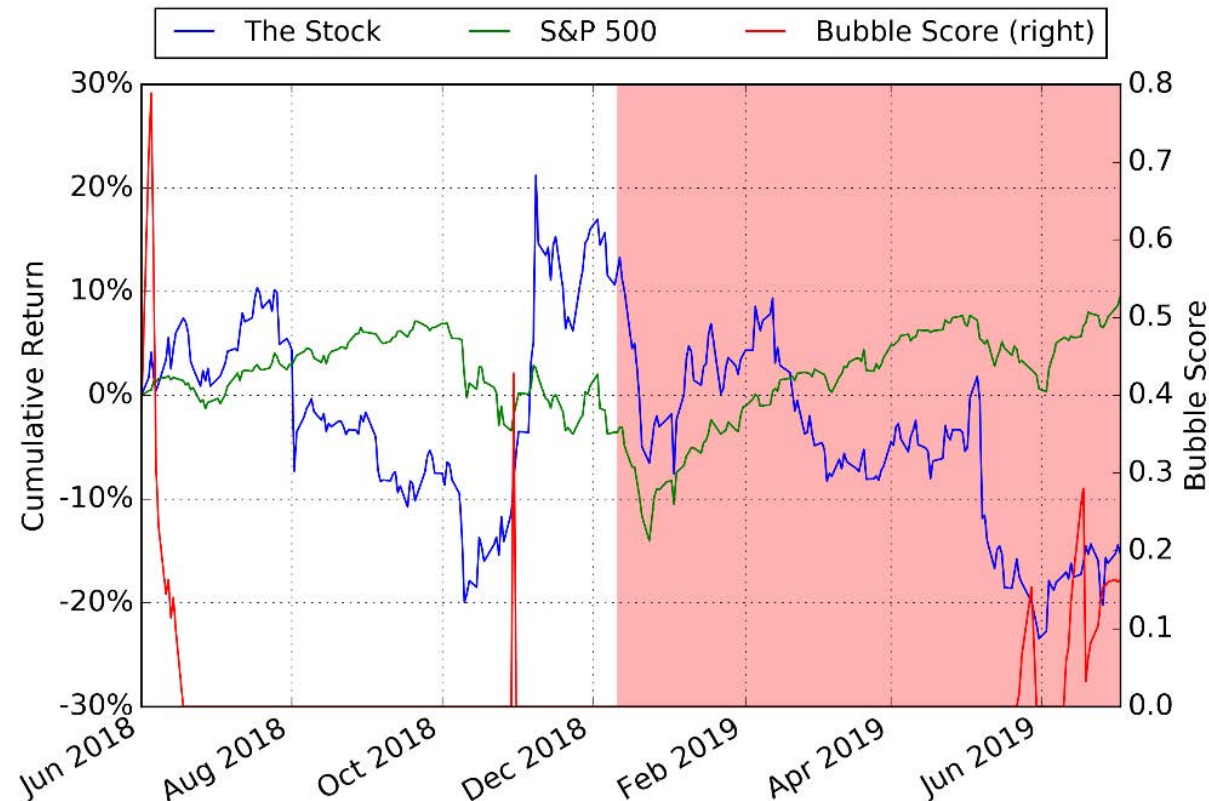
**Quadrant 3 stocks:** strong negative bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Wartsila Oyj Abp	Finland	Capital Goods	-27.7%	-18.9%	Oct-18	-27.1%	27.0%	77.6%
Abiomed Inc	United States of America	Health Care Equipment & Services	-37.7%	-31.9%	Jul-18	-7.6%	1.2%	55.0%
TripAdvisor Inc	United States of America	Media & Entertainment	-19.8%	-17.6%	43435	-15.8%	6.3%	84.3%

# Single Stocks - Quadrant 3 stocks

**Quadrant 3 stocks:** strong negative bubble signals with weak fundamentals

Example: TripAdvisor 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 red shaded period is the negative bubble we identified. The Bubble Score of this seven month bubble has reached 15.8% with a bubble size -17.6%, which is a unmatured negative bubble: it is thus expected to continue depreciating.

# Single Stocks - Quadrant 4 stocks

## Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

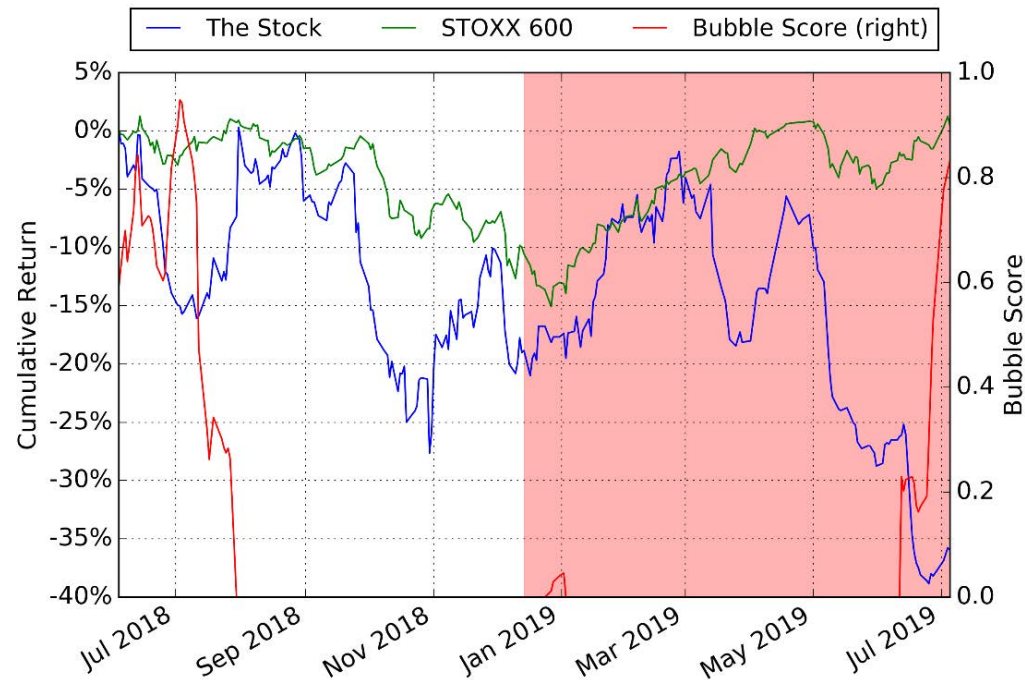
Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Deutsche Lufthansa AG	Germany	Transportation	-25.6%	-28.0%	Jan-19	-83.1%	98.9%	0.2%
Repsol SA	Spain	Energy	-13.5%	-5.9%	Jan-19	-7.5%	96.5%	18.9%
International Consolidated Airlines Group SA	United Kingdom	Transportation	-32.3%	-28.7%	Nov-18	-27.2%	98.5%	8.0%
Electricite de France SA	France	Utilities	-9.0%	-20.2%	Aug-18	-31.3%	93.8%	0.7%
Persimmon PLC	United Kingdom	Consumer Durables & Apparel	-22.3%	-17.1%	Jan-19	-36.3%	97.5%	7.5%
BT Group PLC	United Kingdom	Telecommunication Services	-10.4%	-17.0%	Jan-19	-28.0%	80.5%	25.8%
Royal Mail PLC	United Kingdom	Transportation	-56.1%	-41.1%	Oct-18	-29.2%	94.9%	0.5%
Vodafone Group PLC	United Kingdom	Telecommunication Services	-25.6%	-12.9%	Oct-18	-4.5%	90.8%	97.5%
SES SA	Luxembourg	Media & Entertainment	-19.4%	-26.7%	Sep-18	-18.6%	74.8%	92.3%
Koninklijke Ahold Delhaize NV	Netherlands	Food & Staples Retailing	-4.7%	-10.3%	Nov-18	-15.8%	90.1%	25.7%
Polski Koncern Naftowy Orlen SA	Poland	Energy	18.0%	-9.5%	Nov-18	-23.7%	95.9%	98.3%
Centene Corp	United States of America	Health Care Equipment & Services	-22.7%	-22.7%	Jul-18	-24.9%	96.1%	45.5%
Kroger Co	United States of America	Food & Staples Retailing	-22.3%	-28.9%	Nov-18	-24.2%	60.3%	83.5%



# Single Stocks - Quadrant 4 stocks

**Quadrant 4 stocks:** strong negative bubble signals with strong fundamentals

Example: Deutsche Lufthansa AG.

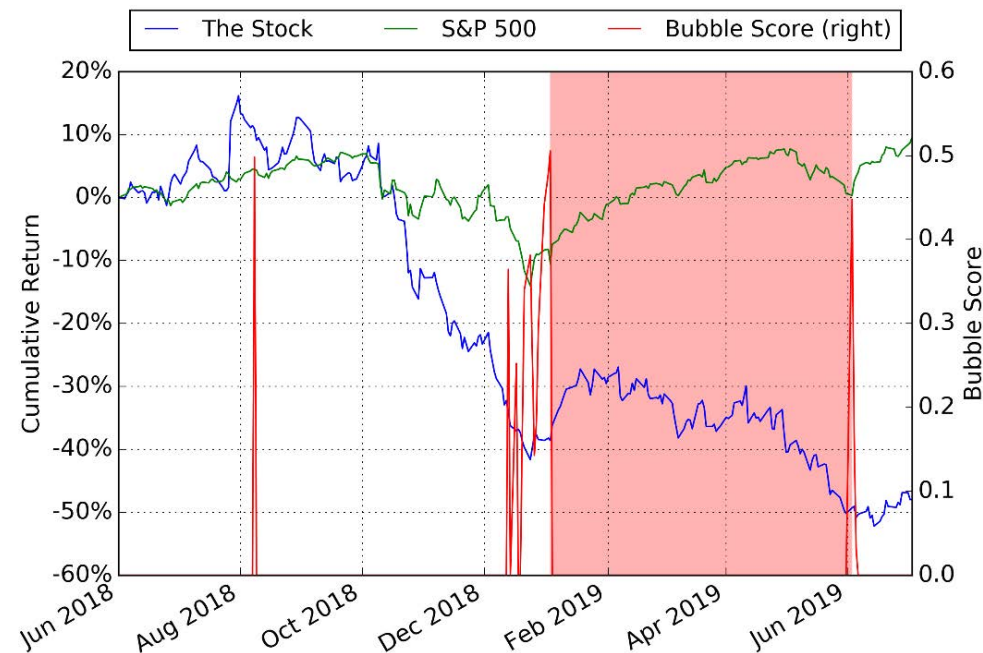


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this six month bubble has reached 83.1% with a bubble size -28%. 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.

# Single Stocks - Quadrant 4 stocks

**Last month example:** strong negative bubble signals with strong fundamentals, National Oilwell Varco Inc.

The figure below plots the one year cumulative return of the stock (blue), S&P 500 (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 stopped its drawdown and started a correction recently, which is in agreement with our DS LPPLS indicator and the strong fundamentals. We expect this stock to further rebound in the future, given the maturing negative bubble and the strong fundamentals.



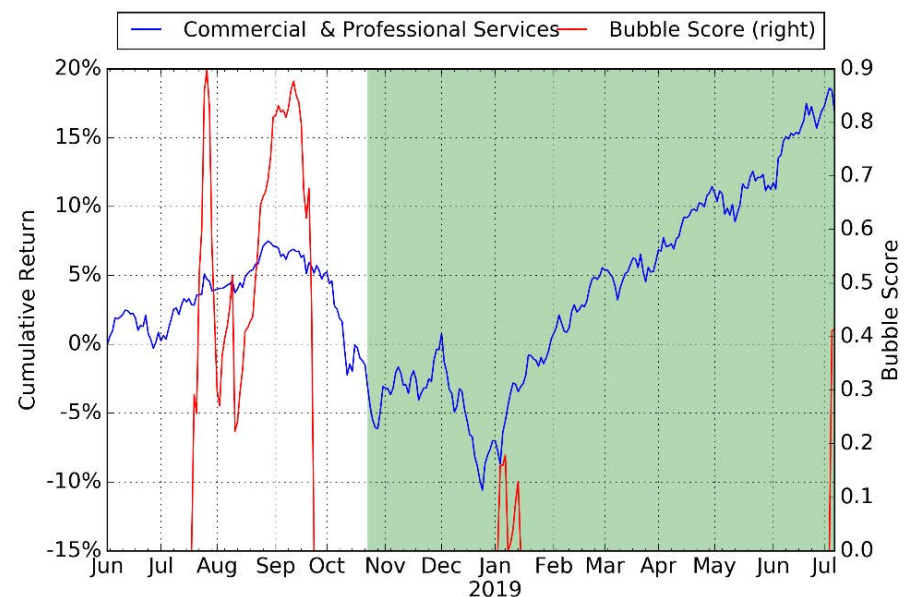
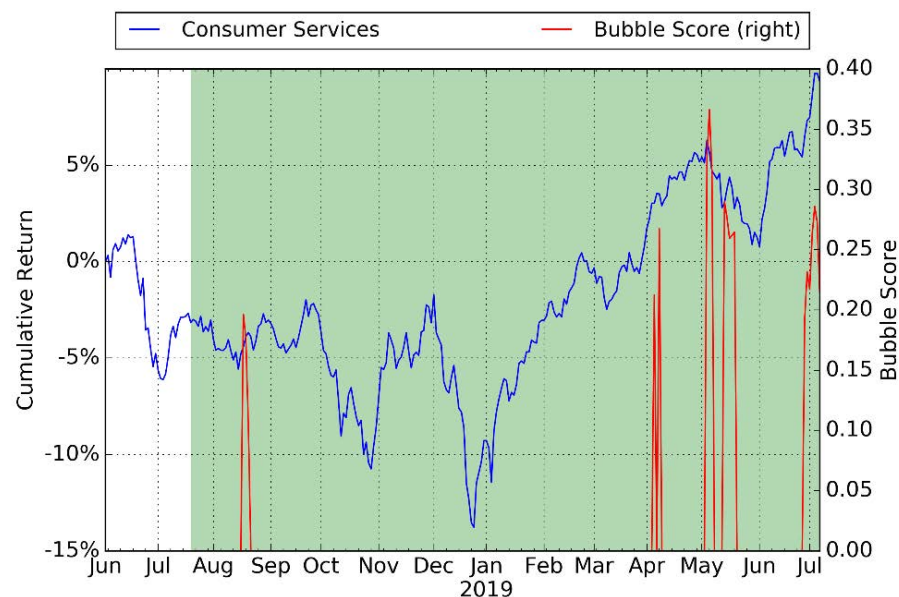
# Sectors

GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	July 1st	June 1st	July 1st	June 1st	July 1st	June 1st	July 1st	June 1st	July 1st	June 1st
Pharmaceuticals, Biotechnology & Life Sciences	5.7%	1.2%	0.0%	0.0%	0.0%	0.0%	71.1%	71.7%	50.4%	50.1%
Consumer Services	12.9%	-0.1%	12.9%	0.0%	21.5%	0.0%	31.8%	31.2%	48.9%	49.3%
Retailing	4.6%	-3.0%	0.0%	0.0%	0.0%	0.0%	19.4%	20.5%	55.4%	55.3%
Transportation	3.6%	-5.6%	0.0%	0.0%	0.0%	0.0%	53.8%	53.8%	50.4%	49.4%
Consumer Durables & Apparel	0.4%	-10.2%	0.0%	0.0%	0.0%	0.0%	33.8%	34.6%	56.0%	52.4%
Semiconductors & Semiconductor Equipment	-3.6%	-19.1%	0.0%	0.0%	0.0%	0.0%	64.3%	62.9%	32.3%	31.5%
Technology Hardware & Equipment	7.4%	-6.1%	0.0%	0.0%	0.0%	0.0%	69.5%	68.5%	42.9%	42.1%
Automobiles & Components	-13.2%	-26.0%	0.0%	0.0%	0.0%	0.0%	74.3%	74.7%	57.8%	57.5%
Telecommunication Services	4.2%	-2.0%	0.0%	0.0%	0.0%	0.0%	65.3%	65.3%	42.3%	43.3%
Energy	-13.9%	-18.7%	0.0%	0.0%	0.0%	0.0%	53.2%	53.5%	49.9%	49.6%
Software & Services	14.2%	7.1%	0.0%	0.0%	0.0%	0.0%	34.3%	35.3%	47.0%	47.2%
Materials	-2.9%	-15.5%	0.0%	0.0%	0.0%	0.0%	53.2%	53.8%	47.1%	46.2%
Health Care Equipment & Services	7.2%	-0.1%	0.0%	0.0%	0.0%	0.0%	59.4%	59.9%	49.7%	49.7%
Capital Goods	0.1%	-9.3%	0.0%	0.0%	0.0%	0.0%	49.1%	48.5%	48.6%	49.1%
Media & Entertainment	18.4%	12.6%	0.0%	0.0%	0.0%	0.0%	29.8%	30.6%	44.1%	44.4%
Commercial & Professional Services	13.7%	8.8%	20.7%	0.0%	41.4%	0.0%	29.9%	31.3%	52.5%	52.5%
Food & Staples Retailing	6.3%	1.1%	0.0%	0.0%	0.0%	0.0%	54.1%	53.2%	53.1%	53.1%
Household & Personal Products	17.9%	12.4%	17.9%	0.0%	37.6%	0.0%	33.0%	32.7%	47.2%	49.7%
Food, Beverage & Tobacco	4.6%	1.7%	0.0%	0.0%	0.0%	0.0%	46.3%	46.3%	53.7%	54.1%
Utilities	11.0%	10.4%	0.0%	0.0%	0.0%	0.0%	51.5%	51.1%	44.3%	46.0%
Insurance	12.2%	1.2%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Real Estate	10.0%	6.4%	10.0%	0.0%	23.4%	0.0%	-	-	-	-
Diversified Financials	-0.9%	-10.0%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Banks	-6.8%	-13.8%	0.0%	0.0%	0.0%	0.0%	-	-	-	-

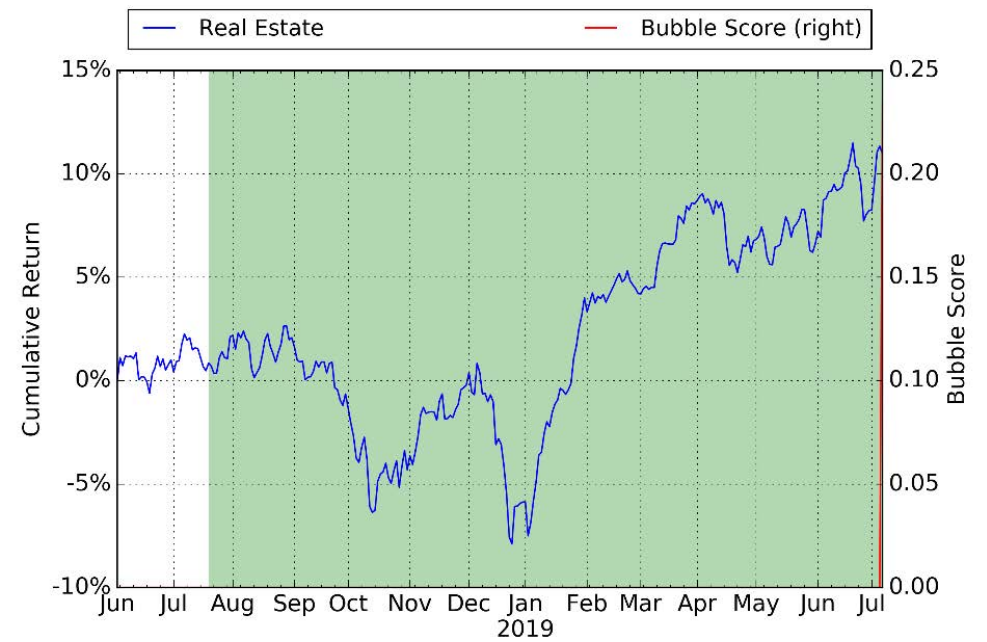
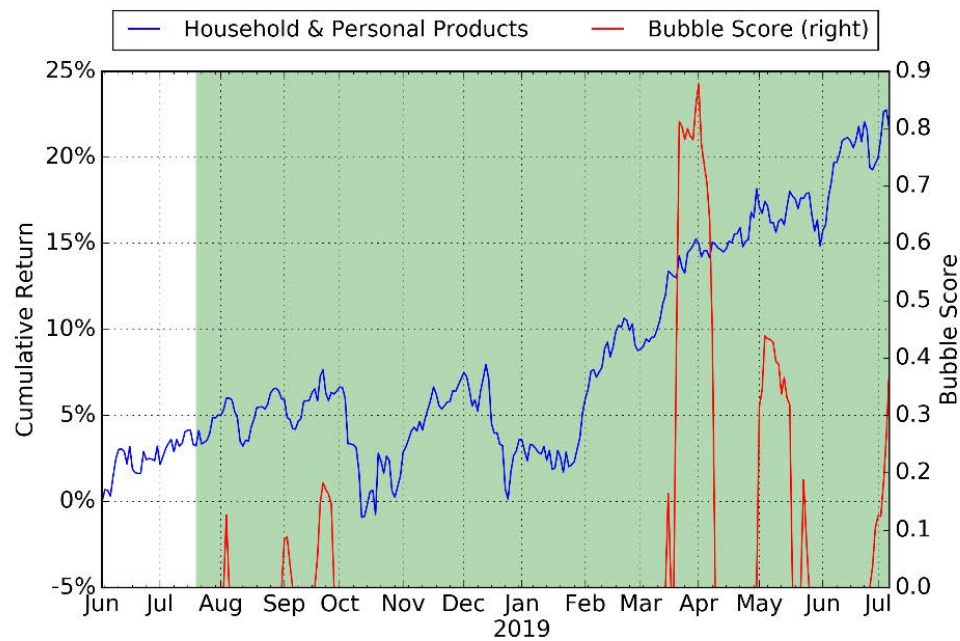
# Sectors

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 4 industry groups with a positive bubble score: *Consumer Services*, *Commercial & Professional Services*, *Household & Personal Products*, and *Real Estate*, as plotted below and in the next slide.



# 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.

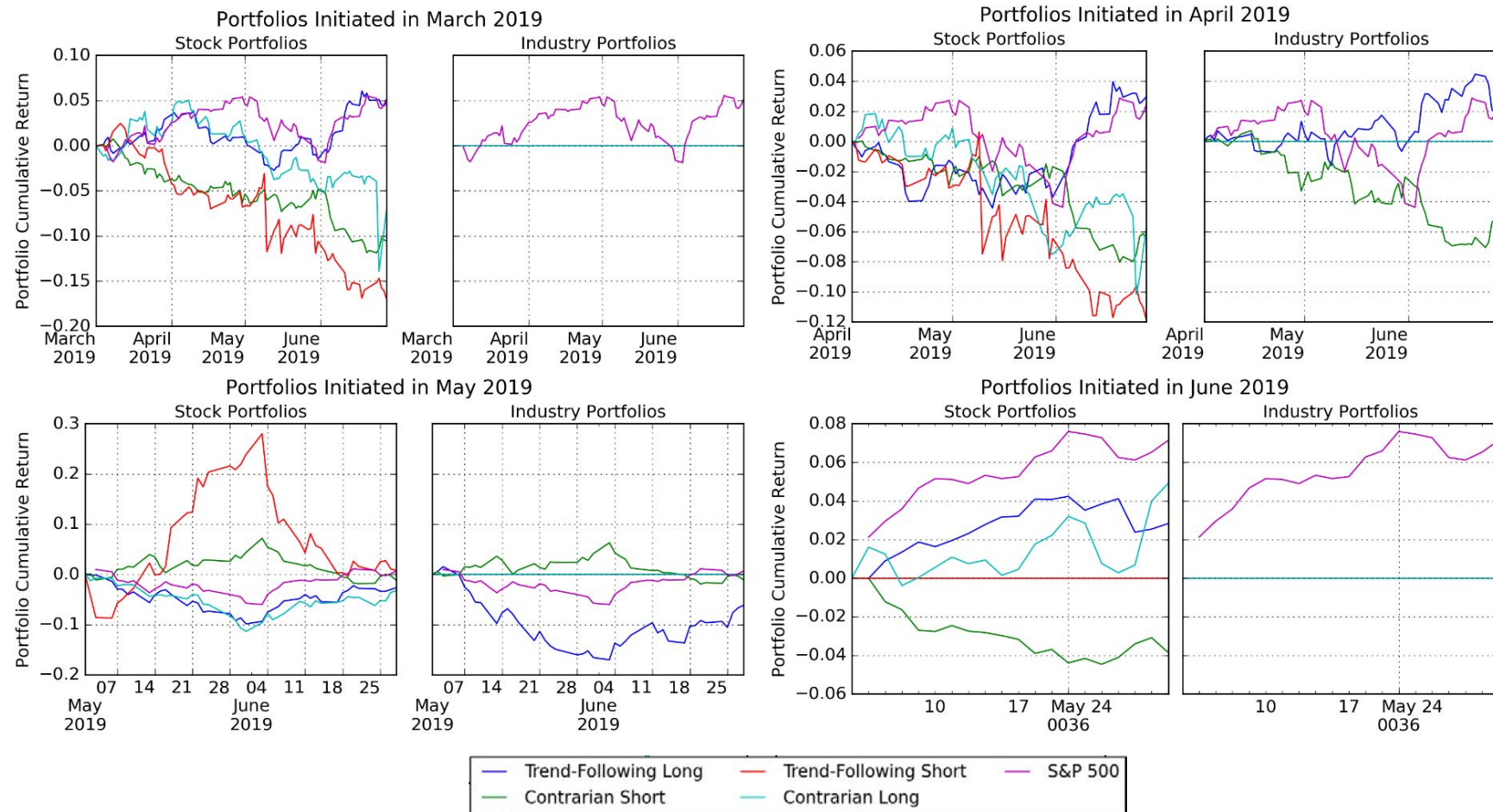
# Portfolio Construction & Performance

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 the market index has outperformed most of the portfolios due to recent market rallies. 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.

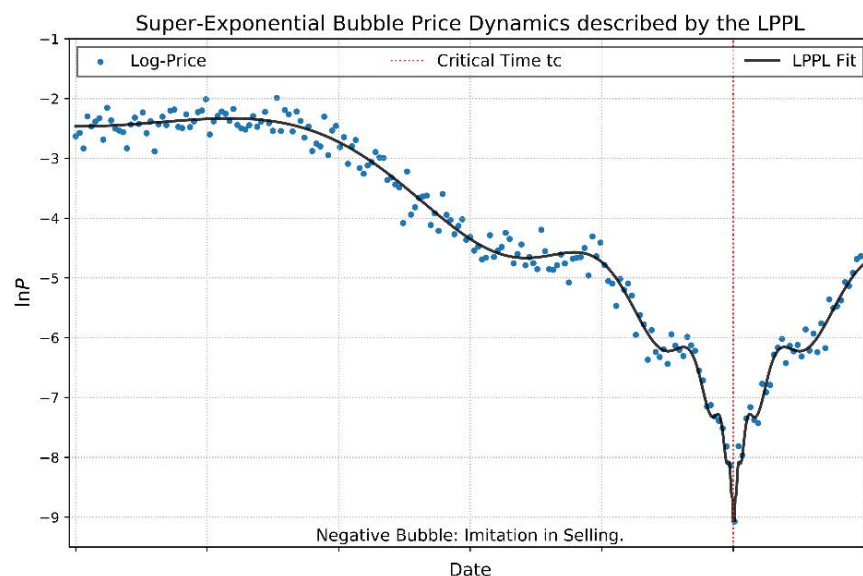
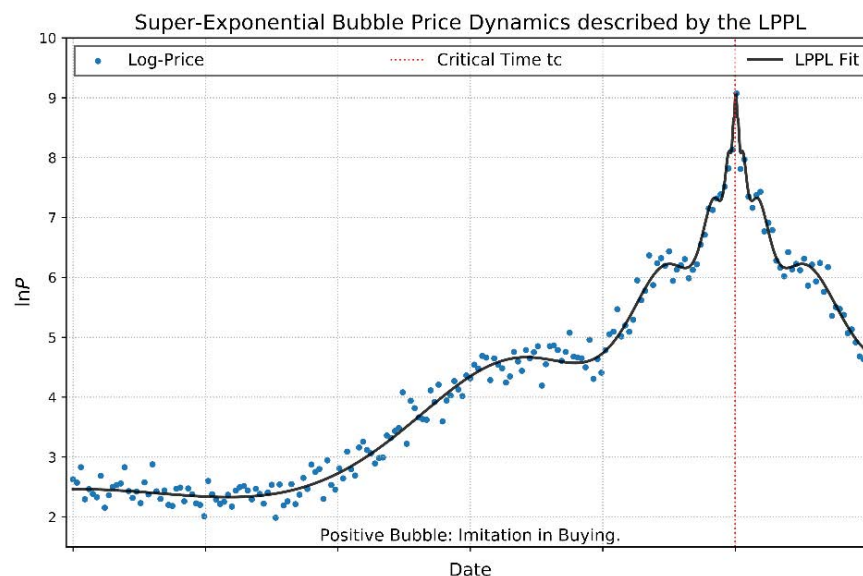
# Appendix

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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.





# 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:

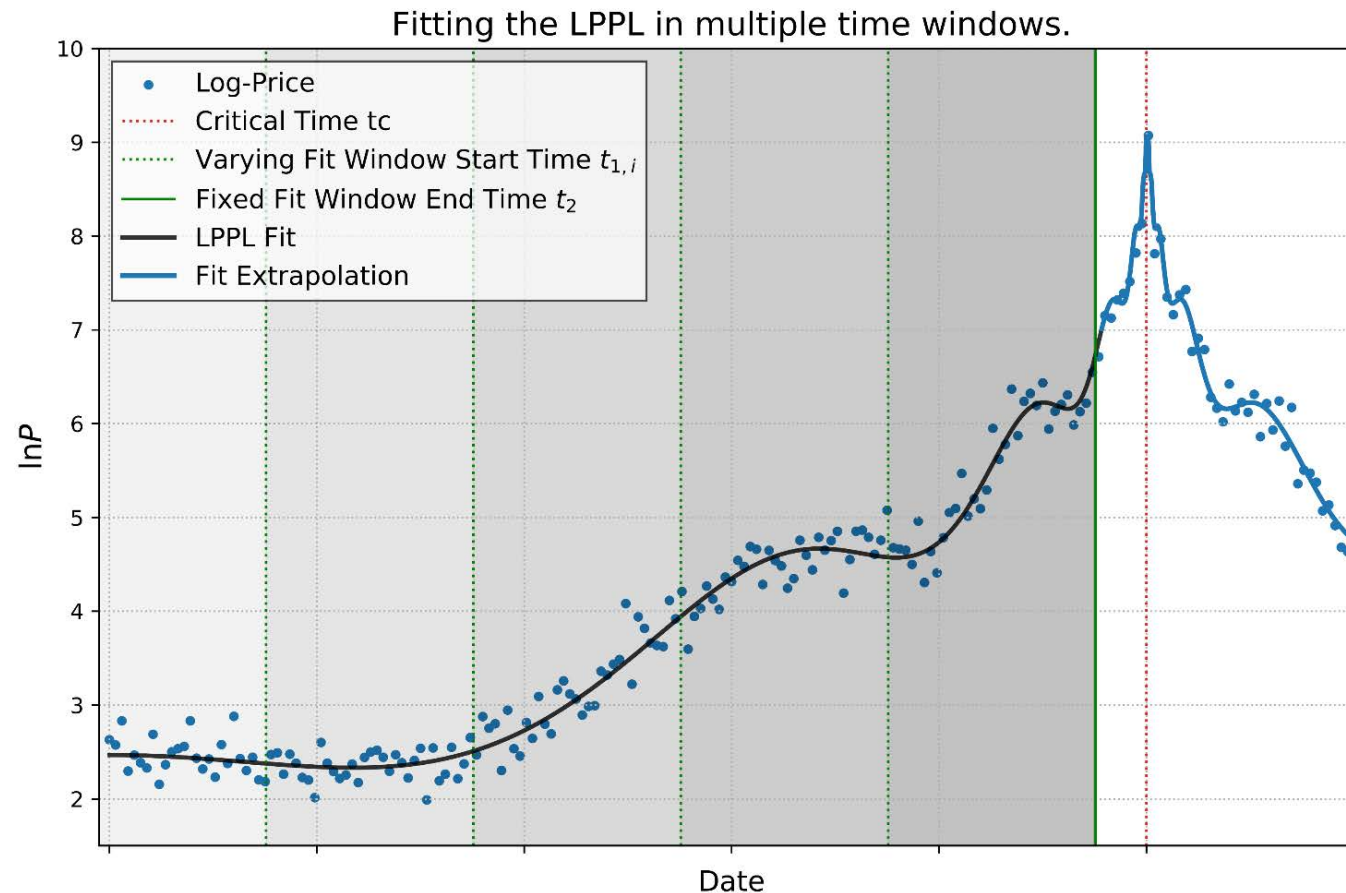
$$LPPLS := E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$

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.
- $\omega$  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



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 (1<sup>st</sup> July 2018 for the present report).

# The DS LPPL Confidence Indicator

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 économiques 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](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  $\mu_{t_c}$  and standard deviations  $\sigma_{t_c}$  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>

# Result Presentation

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.

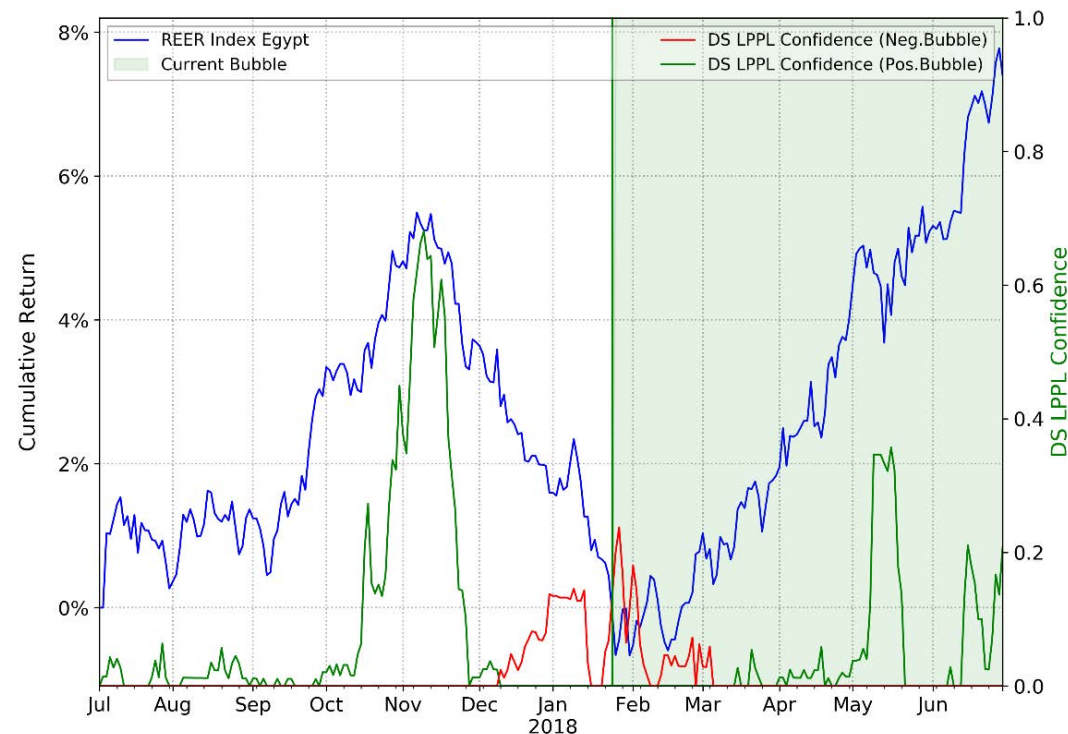
In the table section cluster analysis, the prediction data of the two most probable bubble burst scenarios are presented (see previous slide).

Bubble Data					Cluster Analysis			
	Name	Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [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>