

# The FCO Cockpit Global Bubble Status Report

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# Contents

About

Methodology

General Results

Results per Asset Class

Single Stocks

Sectors

Final Remarks

Appendix

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.

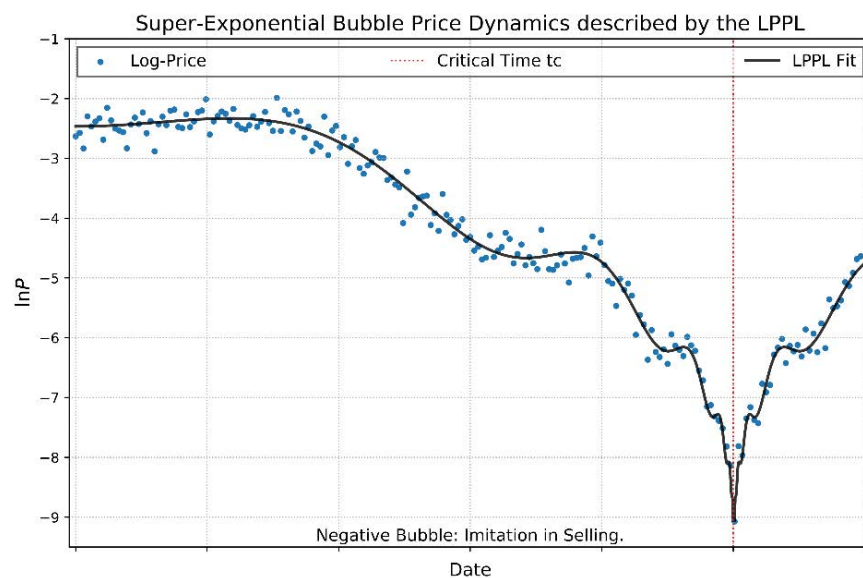
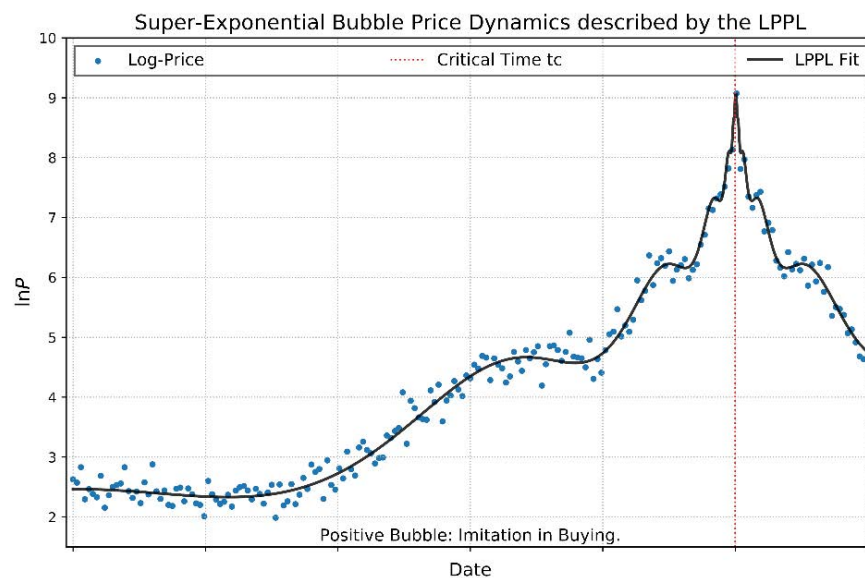
**To new readers, we recommend proceeding to the appendix for more detailed information about the methodology and procedures applied in this report.**

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>

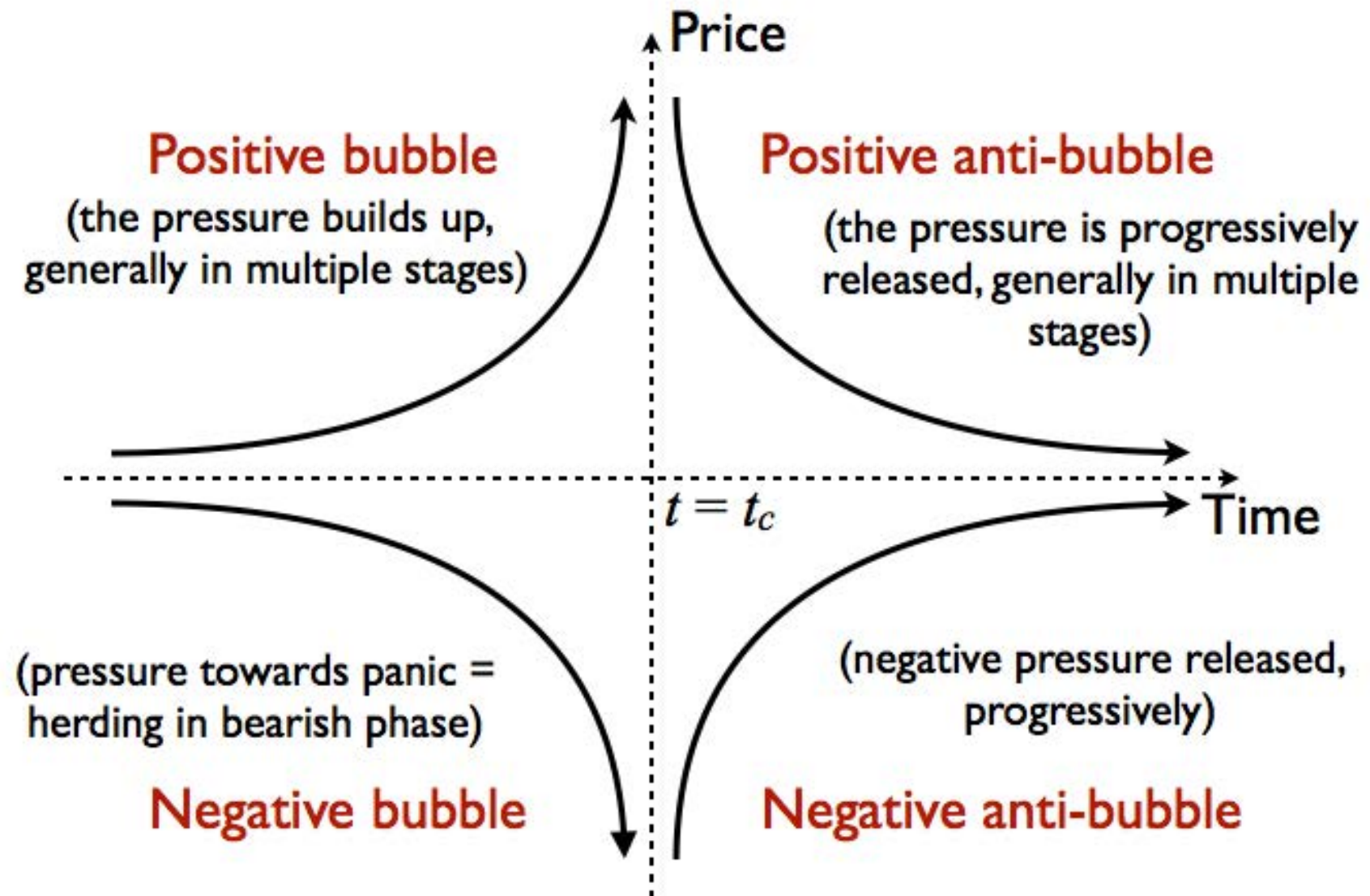
We use the Log-Periodic Power Law Singularity (LPPLS) model to hunt for the distinct fingerprint of **Financial Bubbles**. Basic assumptions of the model are:

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.

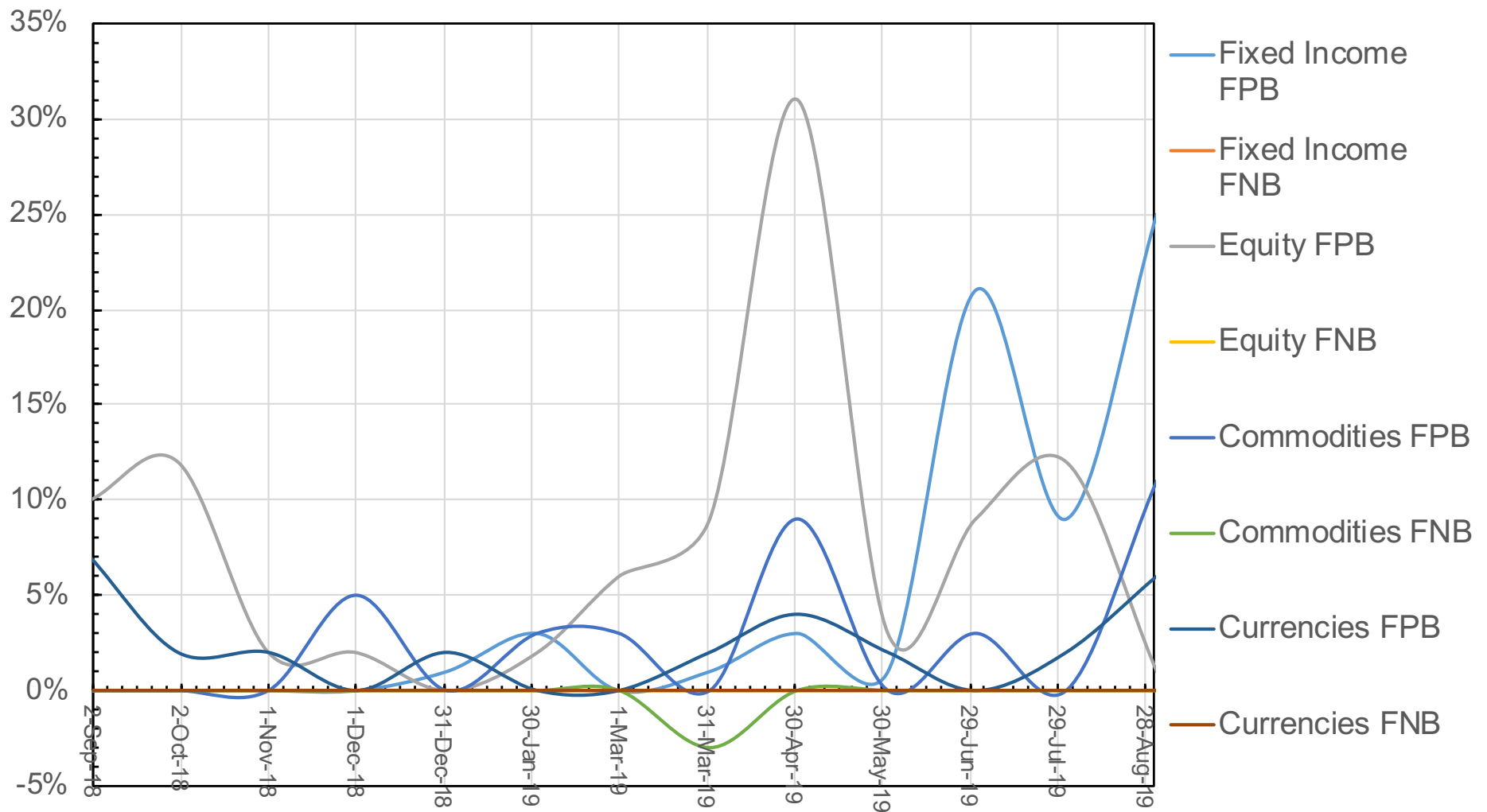


# Bubble Regimes



# 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	25	0
Government Bonds	55	20	0
Finance and Insurance	21	19	0
Corporate Bonds	79	29	0
<b>Equity</b>	297	1	0
Country Indices	66	0	0
Europe	35	3	0
United States	196	2	0
<b>Commodities</b>	35	11	0
<b>Forex</b>	53	6	0

This month, we report a lot of interesting developments in various markets:

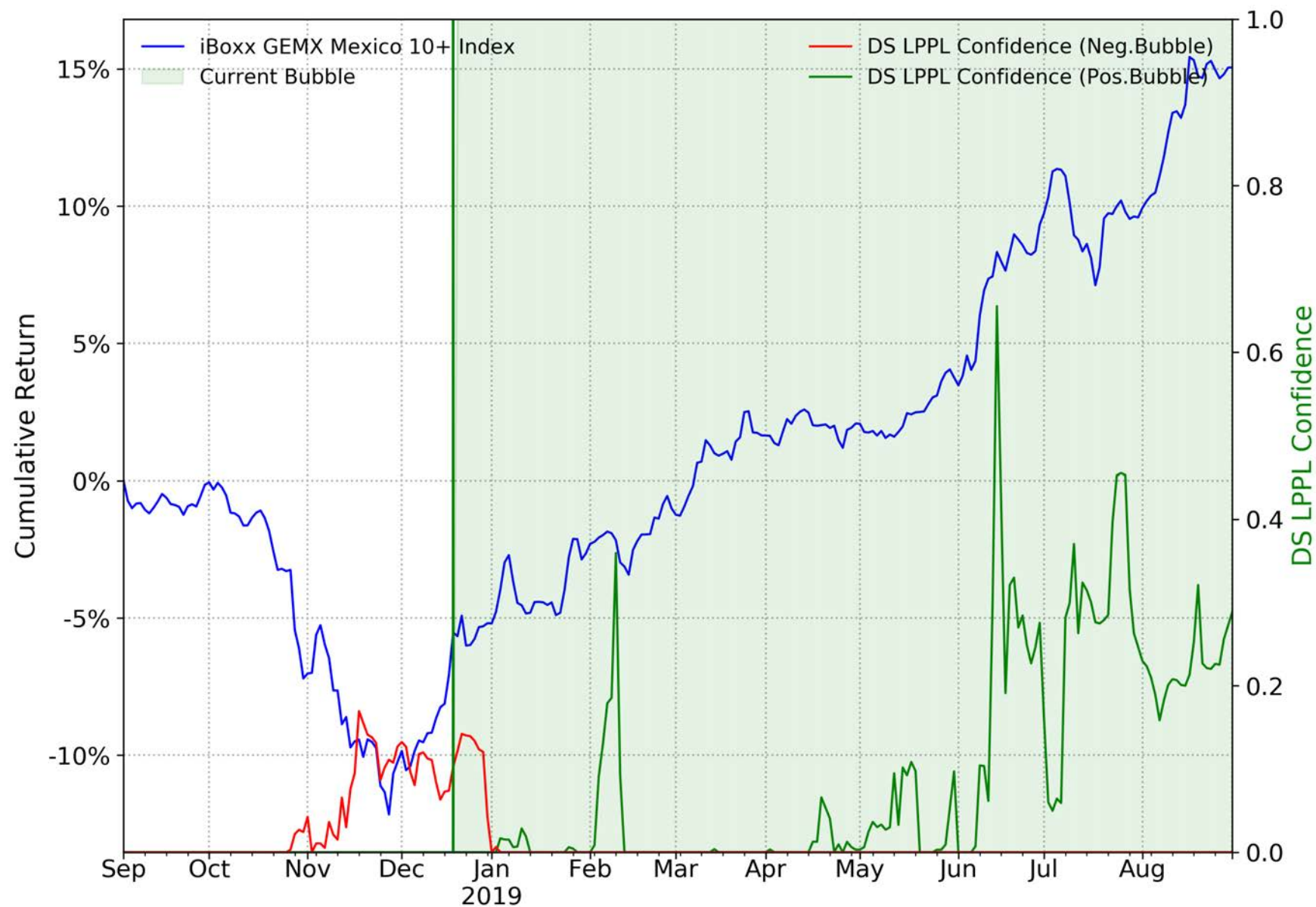
- The fixed income sector experiences rising bubble activity, with a quarter of all analyzed assets showing positive bubble activity.
- Equity positive bubble signals sharply decrease back to 1% from previous 12%.
- Positive bubble signals for commodity indices and in particular precious metal indices rise to a fraction of 11%.
- Slightly increased bubble activity in the forex sector from 2% to 6% and decreased activity in the cryptocurrency sector.

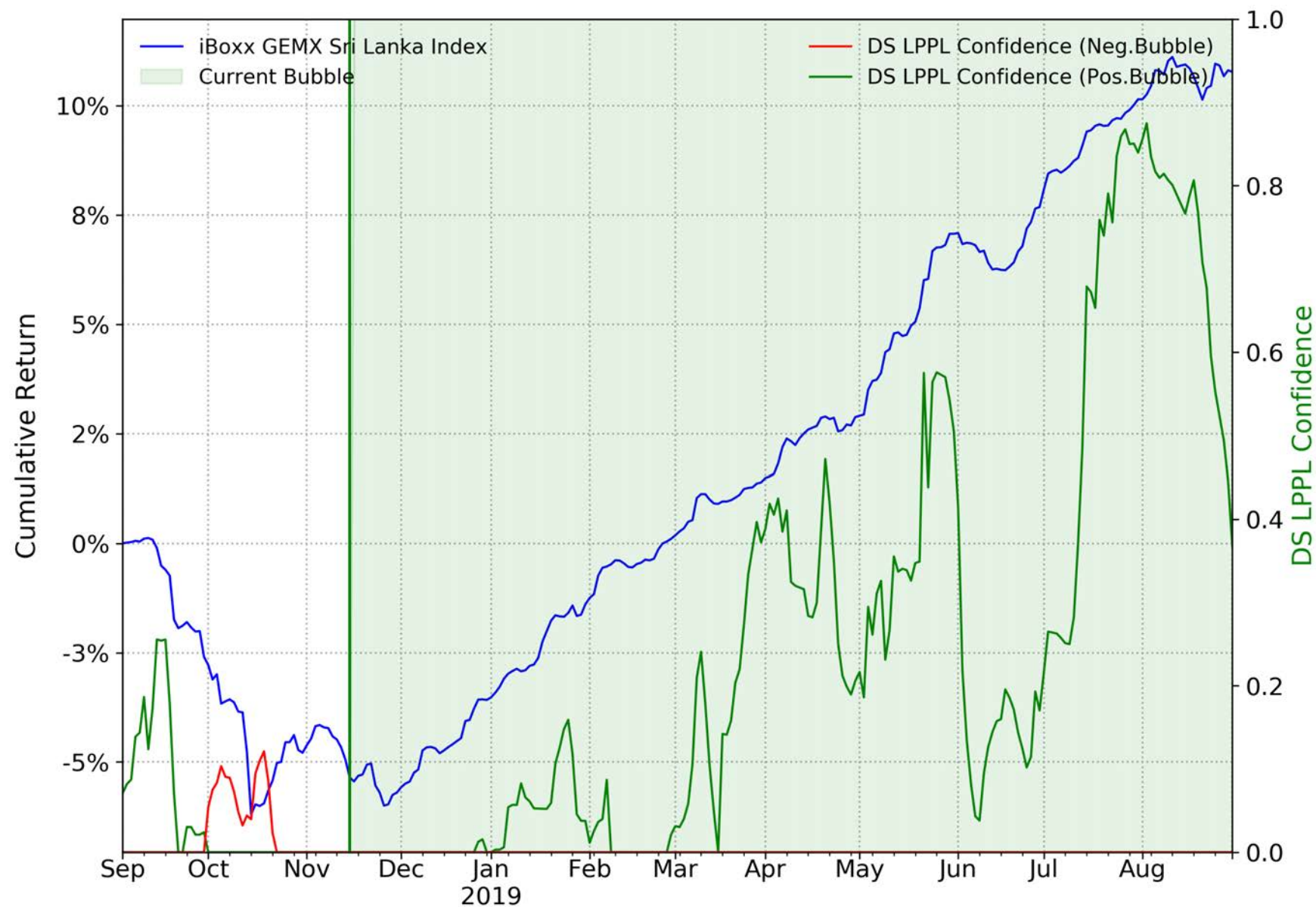
# Fixed Income – Government Bond Indices

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	22	254	29	25	2019-10-27	7	69
2	iBoxx GEMX Sri Lanka Index	17	288	37	25	2019-09-04	5	38
3	iBoxx GEMX Mexico Index	15	254	36	23	2019-10-20	9	79
4	iBoxx Asia Thailand Index	16	328	20	18	2019-09-06	4	68
5	iBoxx Asia Thailand Government Index	17	328	18	17	2019-09-07	2	62

At the top of our list, we find positive bubble signals for the Mexico and Sri Lanka Government Bond Indices. Both of them already appeared in the previous month. The measured bubble duration is between 8 and 10 months, i.e. the bubbles started around the end of 2018. Both indices are depicted on the following slides, and so is the Phillipines index, which was listed in the previous report. It is still in a positive bubble, however, its signal strength is not amongst the top five, this month. Thus, its bubble characteristics are not stated in the table above.







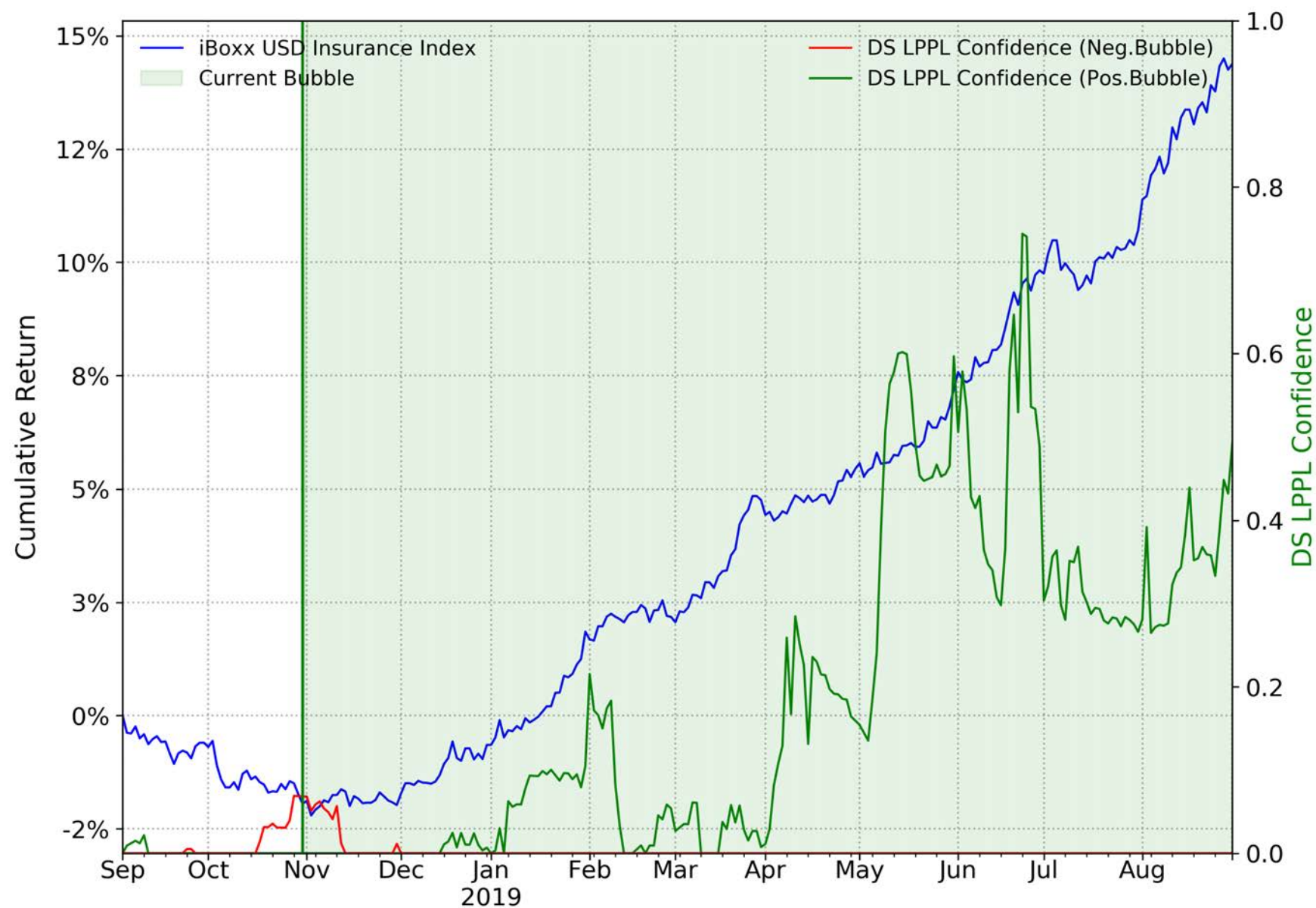


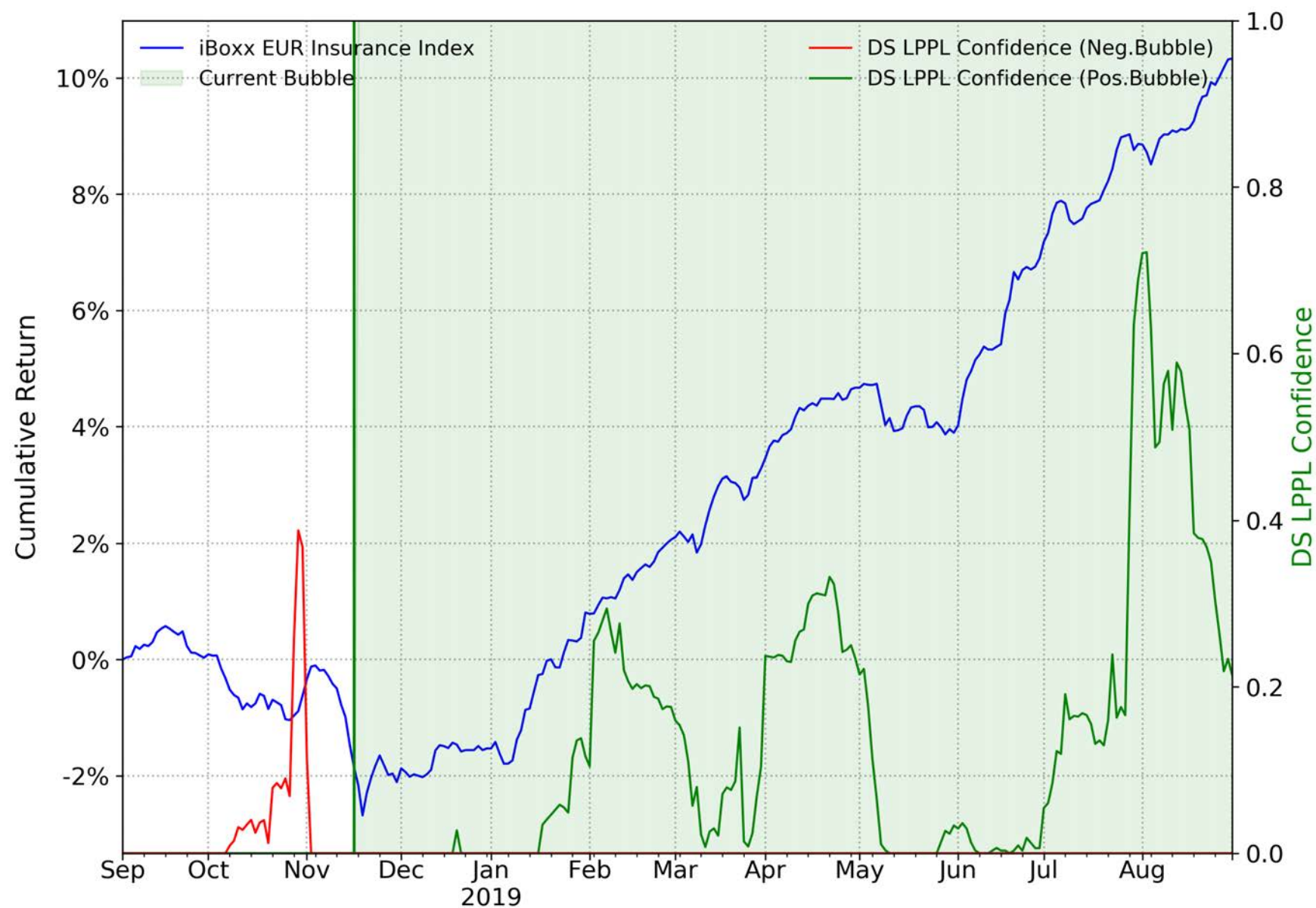
# Fixed Income – Finance & Insurance Indices

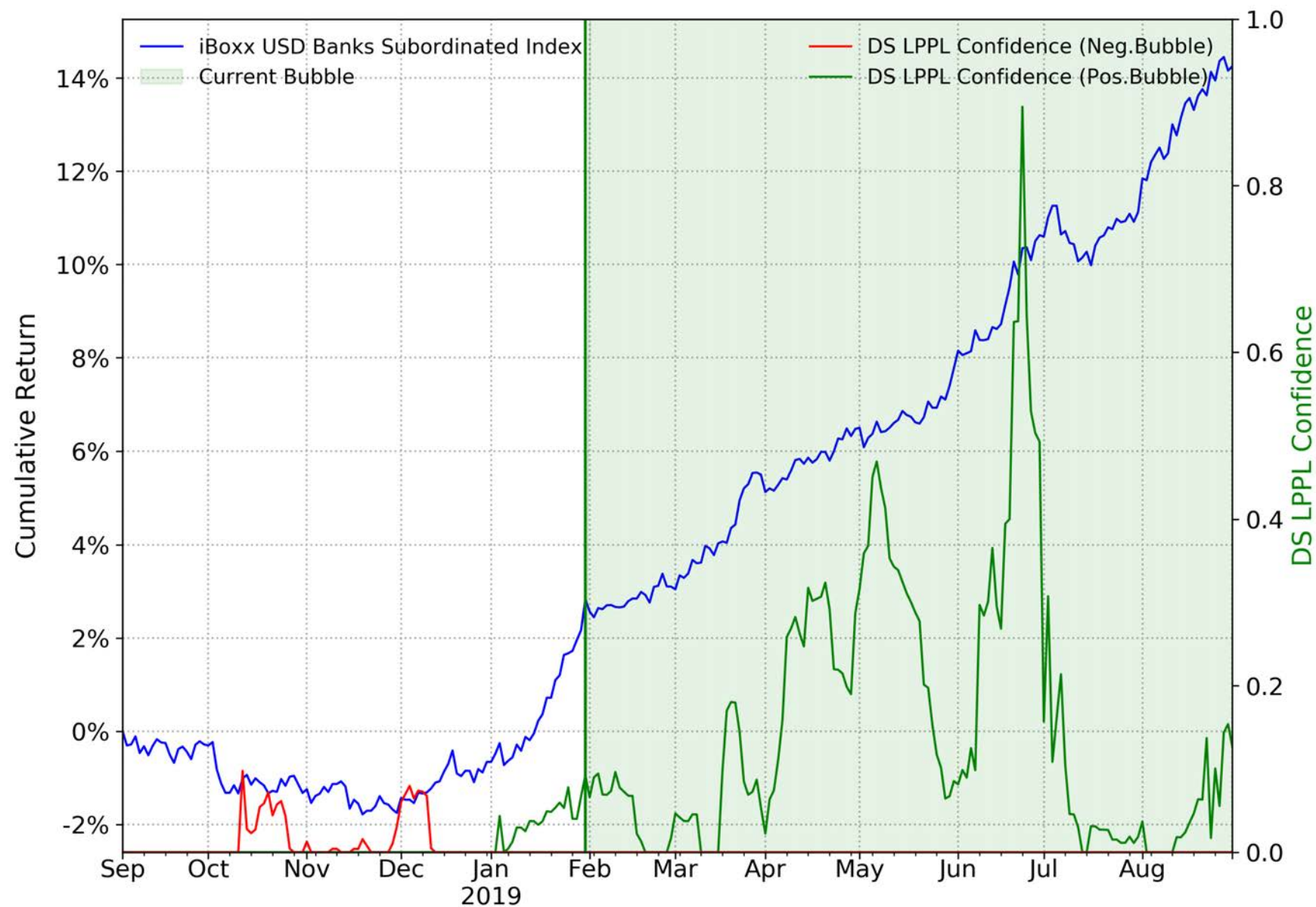
Bubble Data					Cluster Analysis			
Name		Bubble Size $bs$ [%]	Duration [days]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{tc}$	$\sigma_{tc}$ [days ]	Scenario Probability [%]
Positive Bubbles								
1	iBoxx USD Insurance Index	12	184	37	21	2019-09-12	9	80
2	iBoxx EUR Insurance Index	11	226	24	16	2019-12-14	6	37
3	iBoxx USD Banks Subordinated Index	11	211	13	12	2019-12-07	7	36
4	iBoxx USD Financials Subordinated Index	11	211	12	11	2019-12-07	8	37

For a long time, we did not report signals in the banking and insurance section. This month, the fraction of positive bubble signals within this fixed income subclass jumps to 19%. Top-ranked are the USD and EUR Insurance Bond Indices. The confidence indicators for both indices are in the low to medium range, measured bubble sizes cluster at 11-12%. The following slides provide more insight on the development of these indices and the corresponding indicator time series.







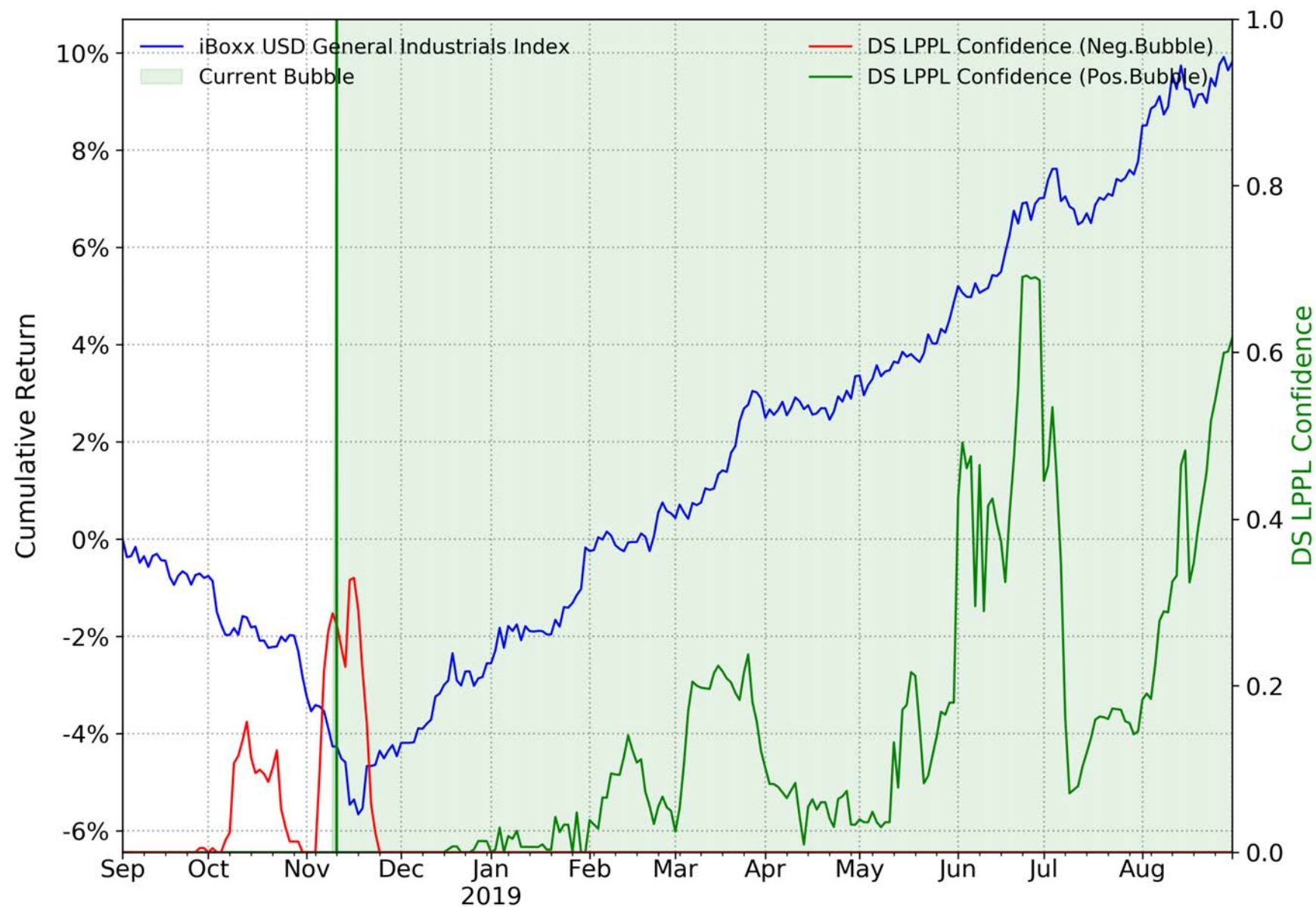


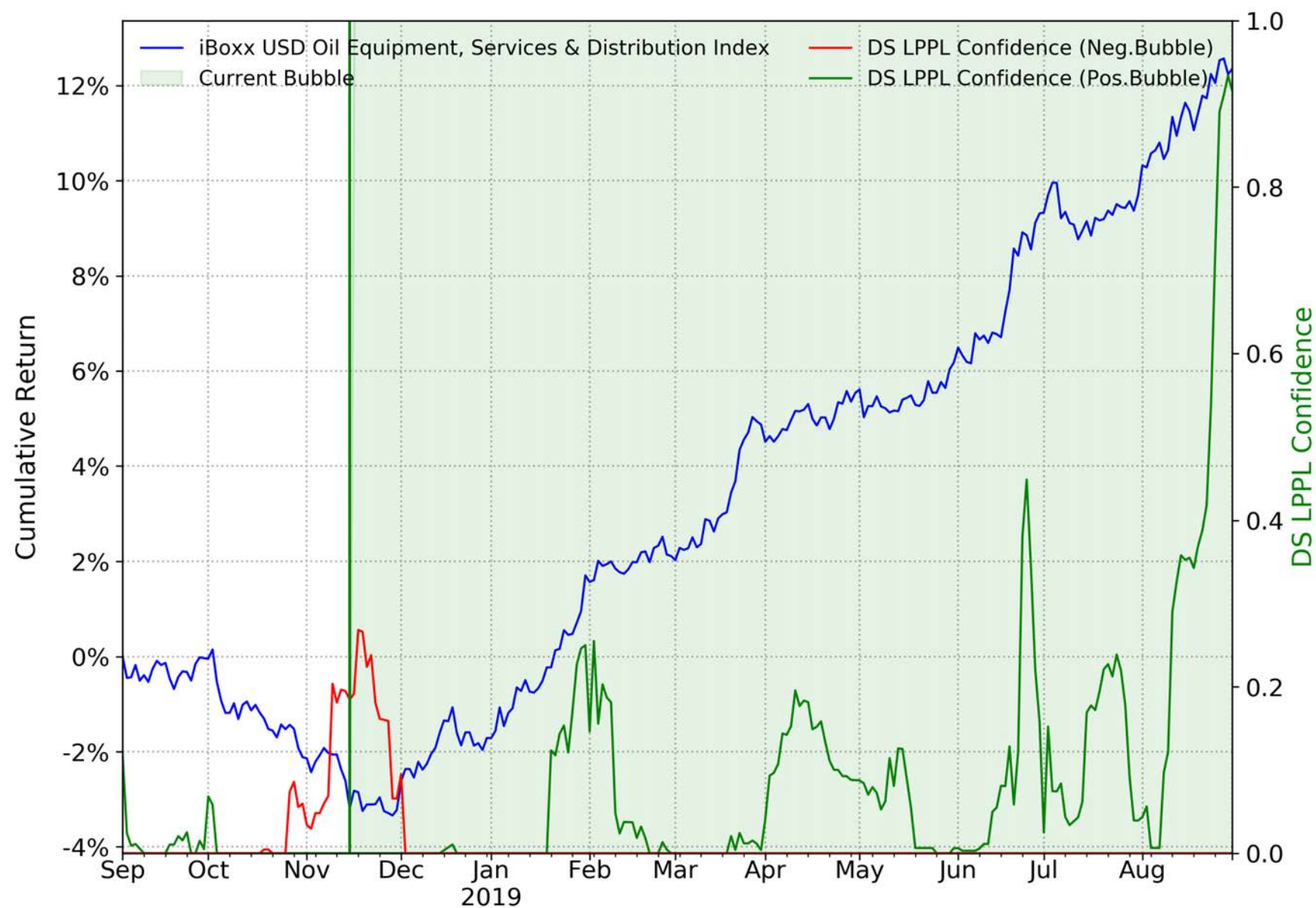
# Fixed Income – Corporate Indices

	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 General Industrials Index	15	293	62	30	2019-10-09	1	27
2	iBoxx USD Oil Equipment, Services & Distributi...	10	182	86	29	2019-09-06	4	94
3	iBoxx USD Nonlife Insurance Index	13	184	61	29	2019-09-14	11	77
4	iBoxx USD Oil & Gas Index	10	211	69	27	2019-09-04	4	57
5	iBoxx USD Basic Materials Index	11	182	65	26	2019-09-13	8	90

Amongst corporate bond indices, we reveal several signs of positive bubble activity. The overall fraction of detected PB signals is 29%. Bubble sizes for the top five signals range from 10-15%, bubble durations from 182-293 days and confidence indicators are quite high with 61-86%. The strength of the top five super-exponential bubble signals is remarkable, as is the measured bubble size, considering that we are dealing with bond indices. In general, our quantitative findings align with the general market sentiment; considering the currently low yields, recently, there has been a lot of talk about a bond market bubble as well as the danger of a (US) economic recession. We however point out the fact that the inverted yield curves, which are often regarded as a popular indicator for recessions, should not be relied on, as they also delivered a lot of false positive signals in the past. Investors should form expectations about central bank policy, instead.



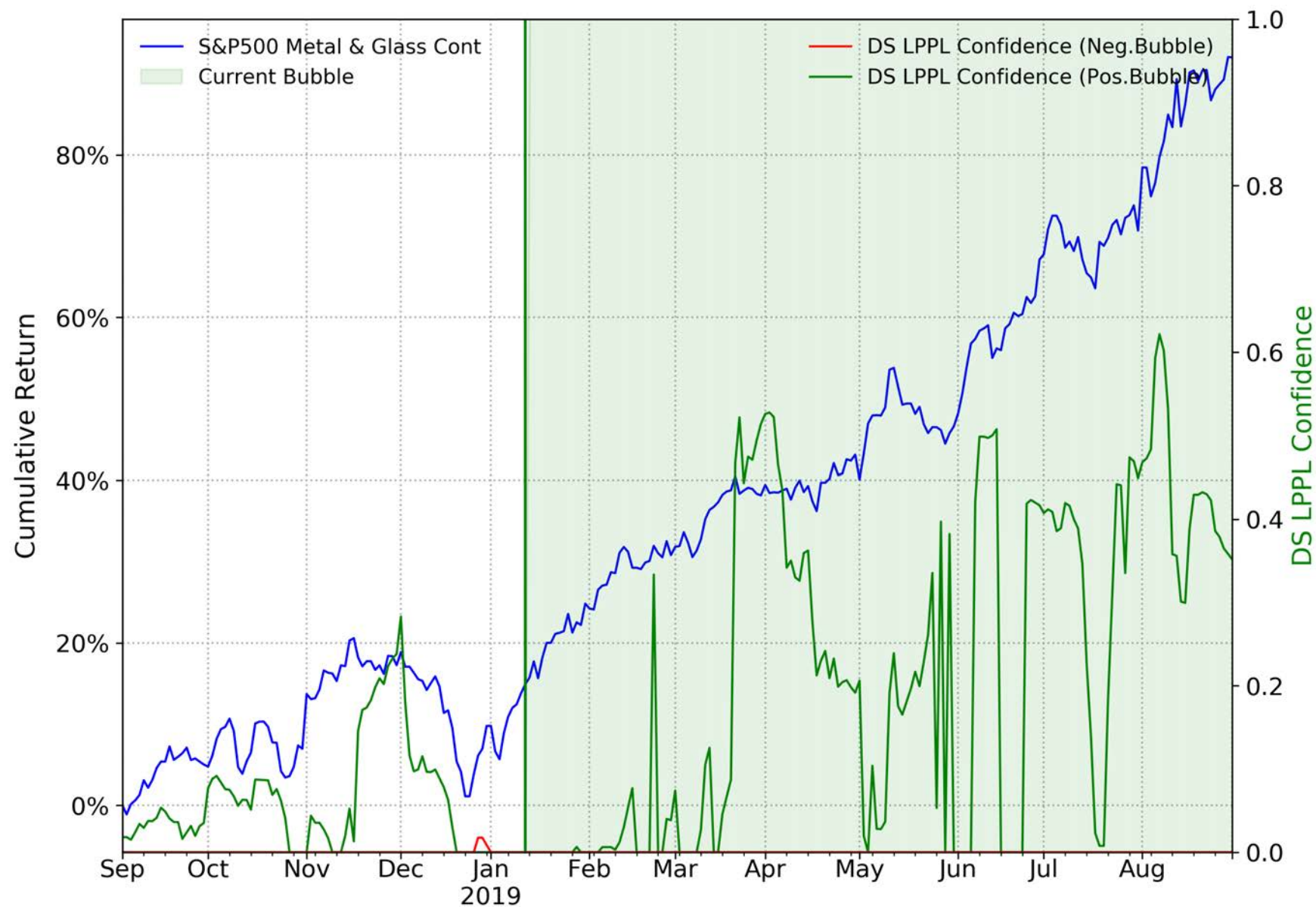




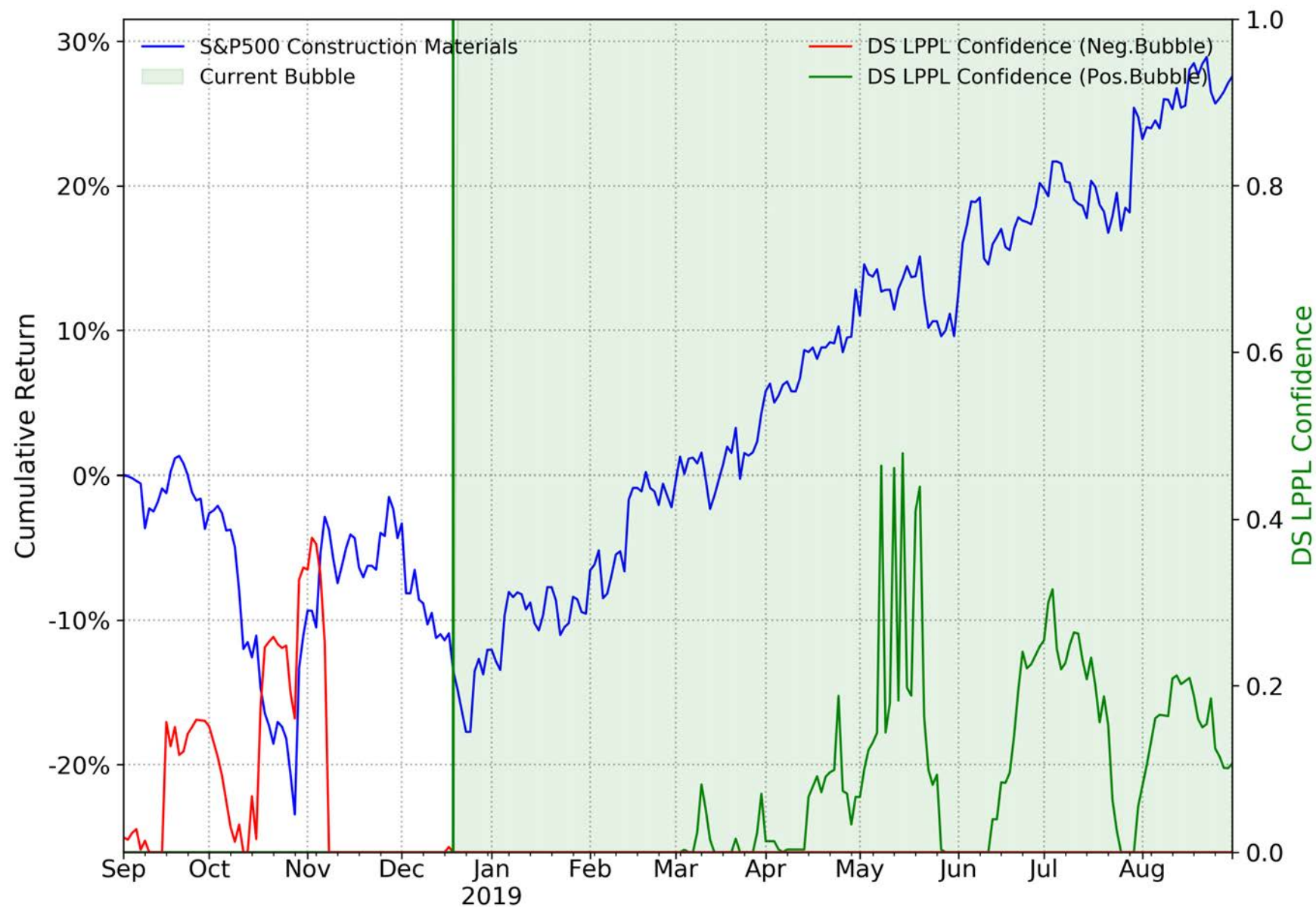
# Equities – United States

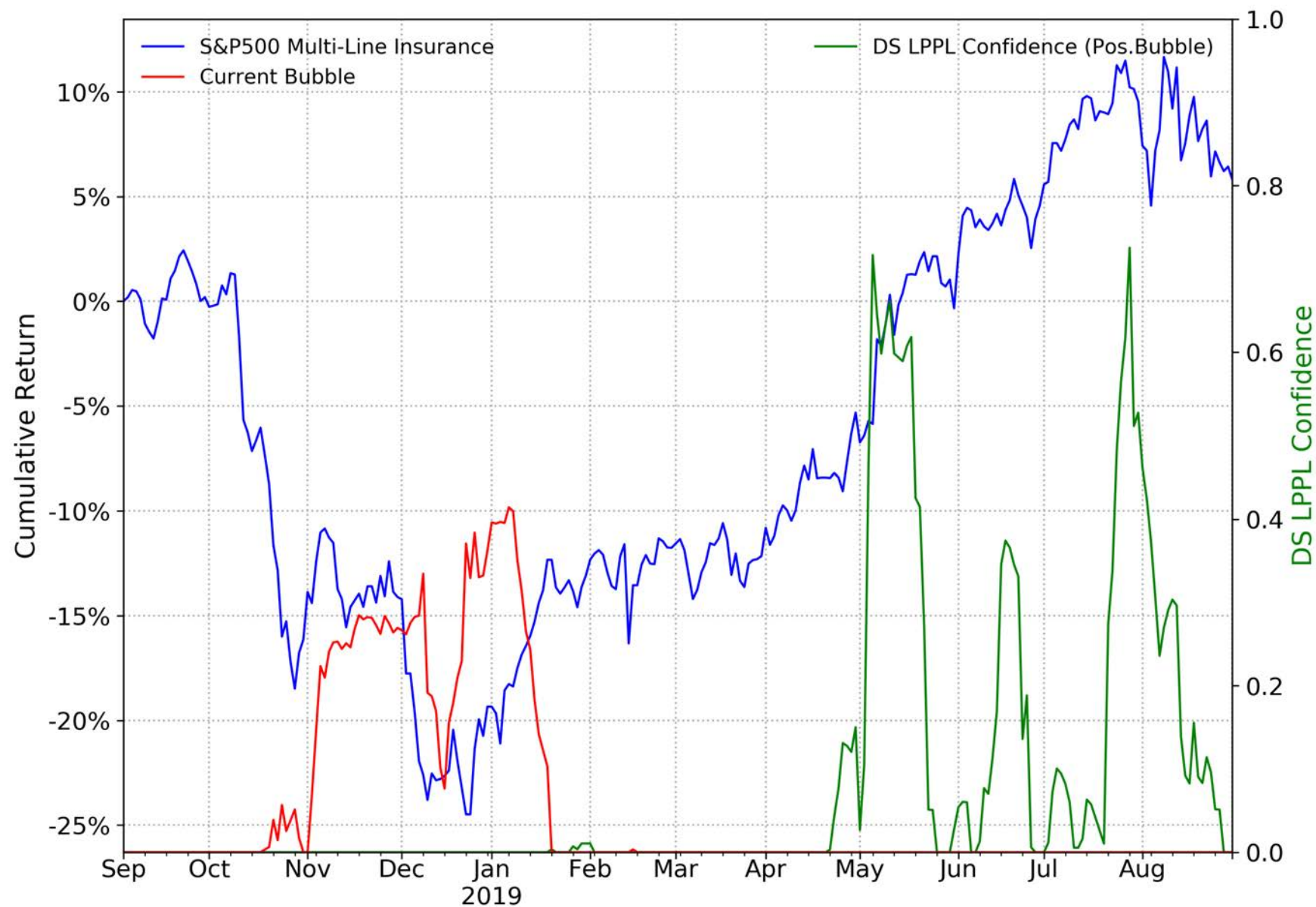
Bubble Data					Cluster Analysis				
	Name	Bubble Size $bs$ [%]	Duration [ $days$ ]	DS LPPL Confidence $ci$ [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{t_c}$	$\sigma_{t_c}$ [ $days$ ] ]	Scenario Probability [%]	
Positive Bubbles	1	S&P500 Metal & Glass Cont	67	231	35	49	2019-09-19	16	70
	2	S&P500 Construction Materials	48	254	11	23	2019-09-02	3	26
	3	S&P500 Construction Materials Si	48	254	11	23	2019-09-02	3	26
	4	S&P500 Fd/Staples Rtl	19	246	20	20	2019-09-26	11	53

In the US Equity sector, the first listed index reappears this month. The estimated bubble size is very large, at 67%, demonstrating the quite remarkable growth of this sector from the beginning of the year. Remarkable are also the bubble sizes of 48% of the second and third listed S&P sub-indices. DS LPPLS Confidence Indicator levels are low to medium, though, indicating that the time series are not dominated by super-exponential dynamics, yet. The corresponding indices, as well as the previously listed Multi-Line Insurance Index, which has undergone a minor correction are depicted on the next pages.









# Equities – European Markets

## 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>							
STOXX Europe 600 Food & Beverage EUR Price Index	35	246	17	24	2019-08-30		18

We detect fewer bubble signals in the European equity class. The only detected signal is found in the Food & Beverage Index and shown below.

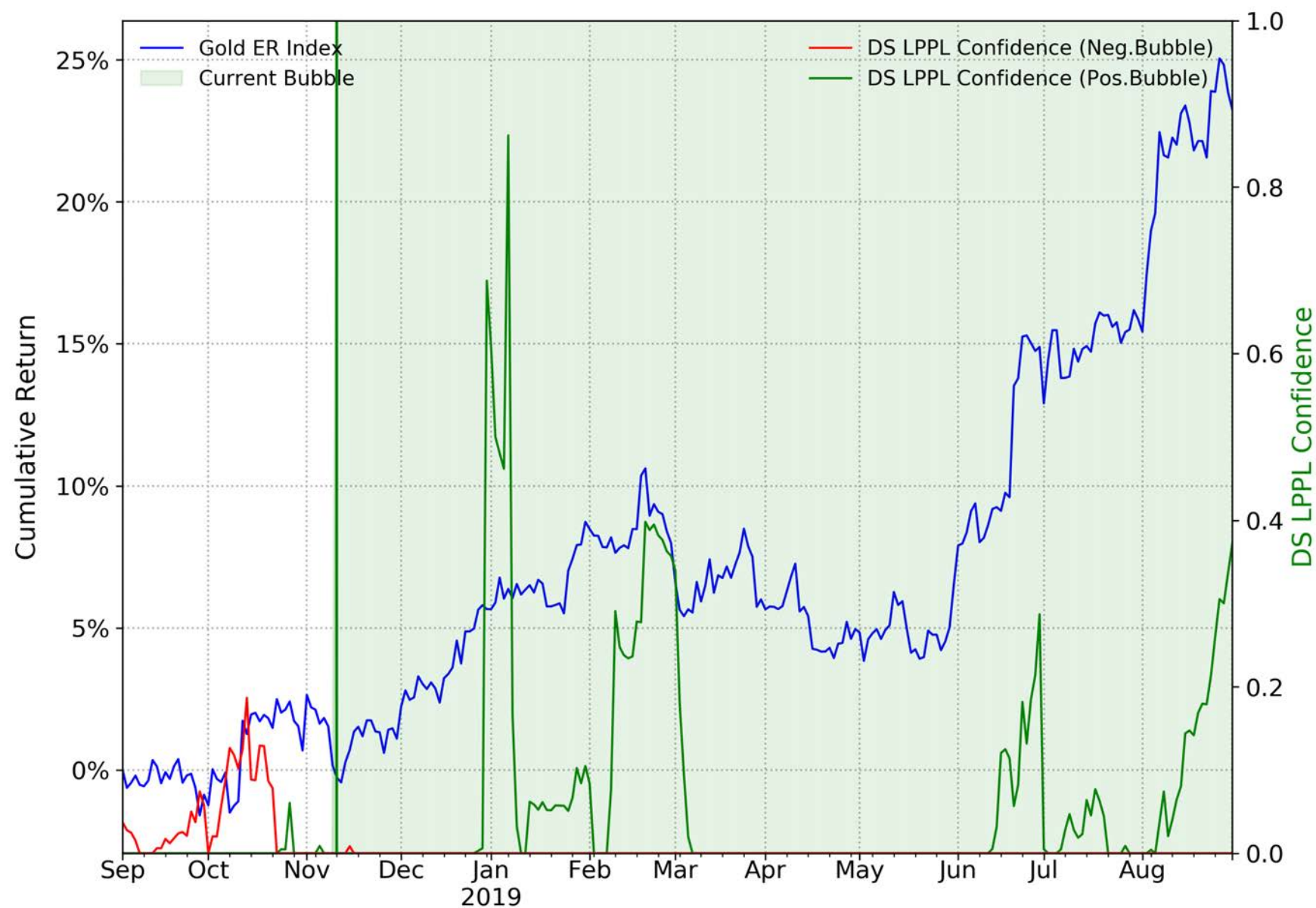


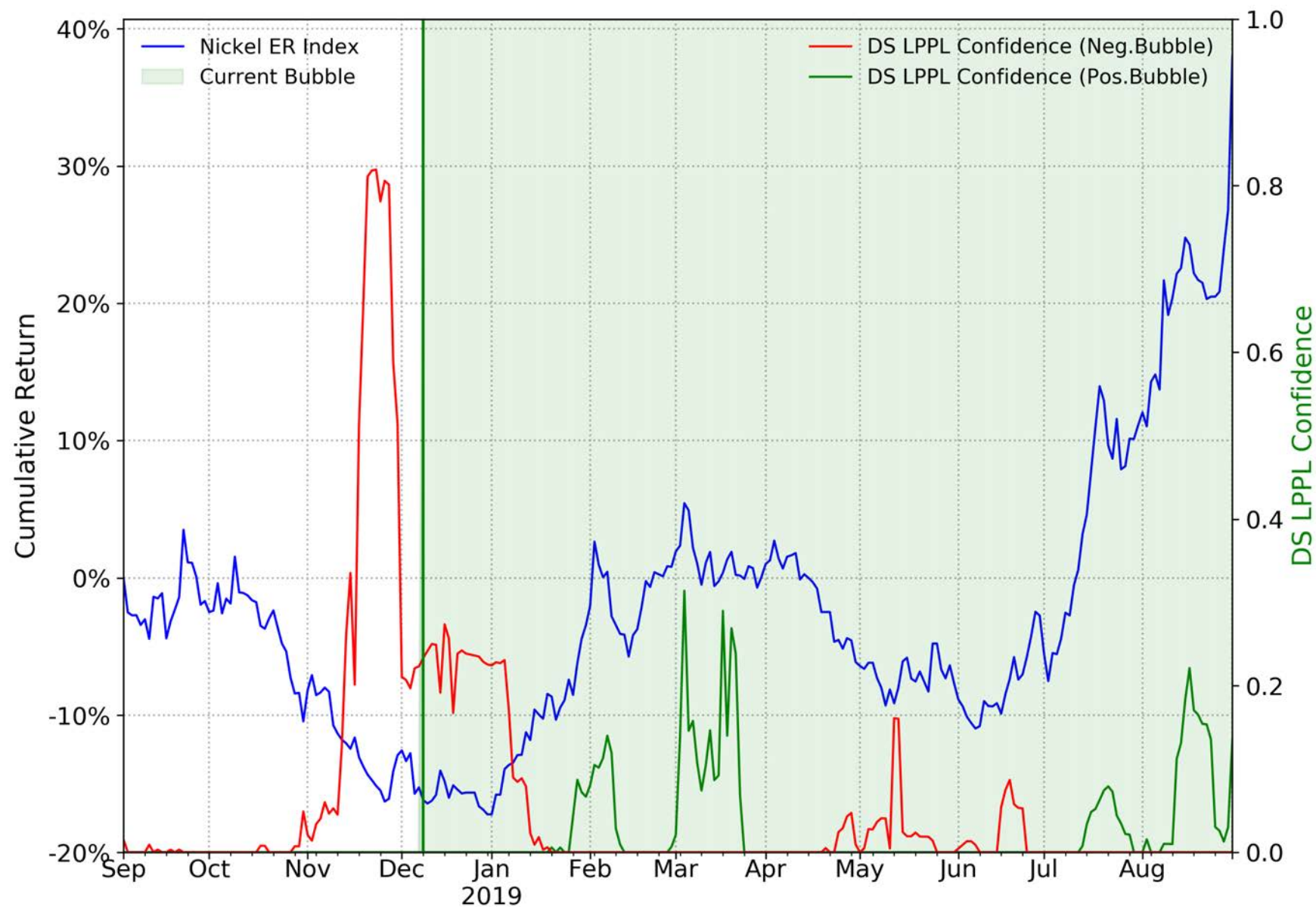
# Commodities

	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	Gold ER Index	17	181	59	31	2019-09-04	1	52
2	Nickel ER Index	65	265	14	30	2020-02-07	20	58
3	Prcs Mtls ER Index	17	139	45	27	2019-09-18	10	75
4	Silver ER Index	27	293	12	18	2020-02-22	8	56

After several months of low bubble activity, the fraction of positive bubbles within the commodity sector jumps up to 11% at the start of September. Gold (and precious metals), traditionally seen as a safe haven during times of uncertainty and crisis, have recently surged in value, as visible on the next slides. Presumably, this is attributable to recent critical developments such as new tariffs in the US China trade war, as well as increased pressure during the Brexit debate and the fear of a 'cold Brexit'. A look at the CBOE VIX in fact shows that, over the previous couple of months, the implied volatility has been elevated. This coincides approximately with the period of growth of the Gold price. It is the question whether the recent happenings really have such a big impact on the general situation; Brexit and US-China trade war have been thematized for a long time, already. Now, suddenly, there seems to be increased concern and uncertainty about these topics. Is this really justified or do investors overestimate the impact of the recent happenings? Indeed, gold could show a correction as result of potentially wrong perception of these events.







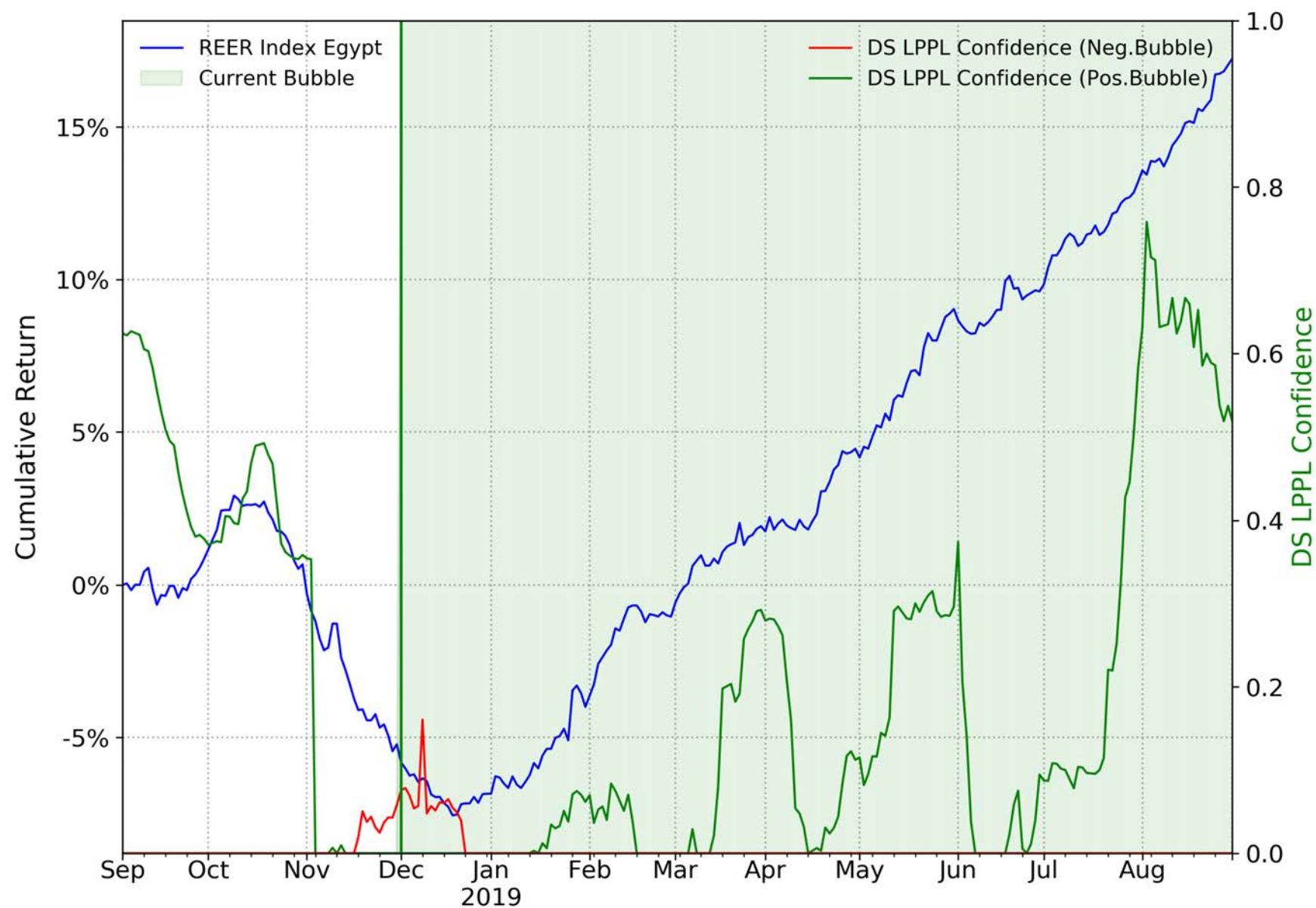


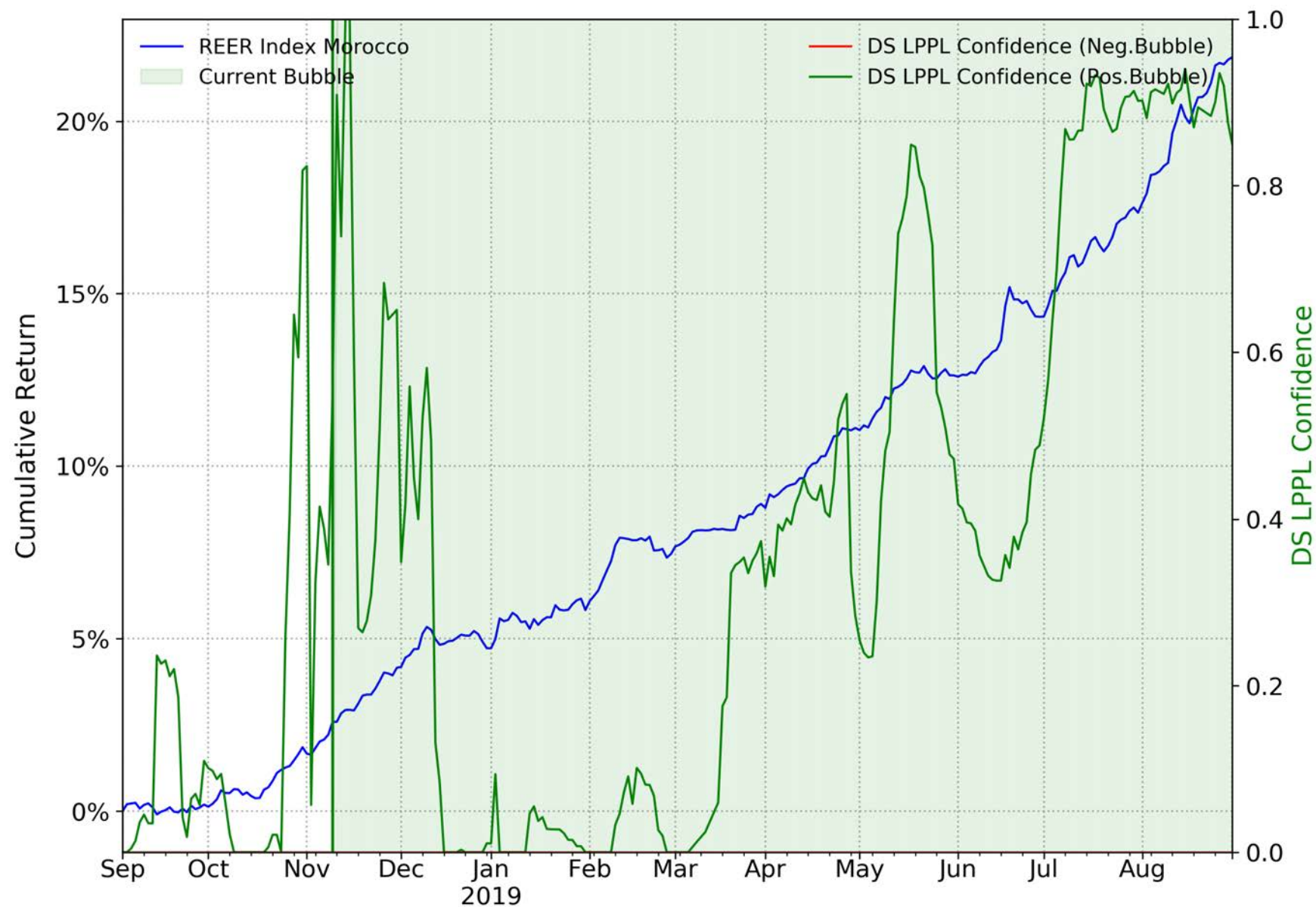
# Currencies

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	REER Index Egypt	25	272	52	36	2019-09-12	17	65
2	REER Index Morocco	10	132	61	25	2019-09-03	2	45
3	REER Index Nigeria	10	140	39	20	2019-09-06	9	69

As in the previous reports, we list the Real Effective Exchange Rate (REER) index Egypt in the currency sector as a positive bubble signal. Newly, we also list the Moroccan and Nigerian indices. Signal time series for all of them are depicted on the following slides.









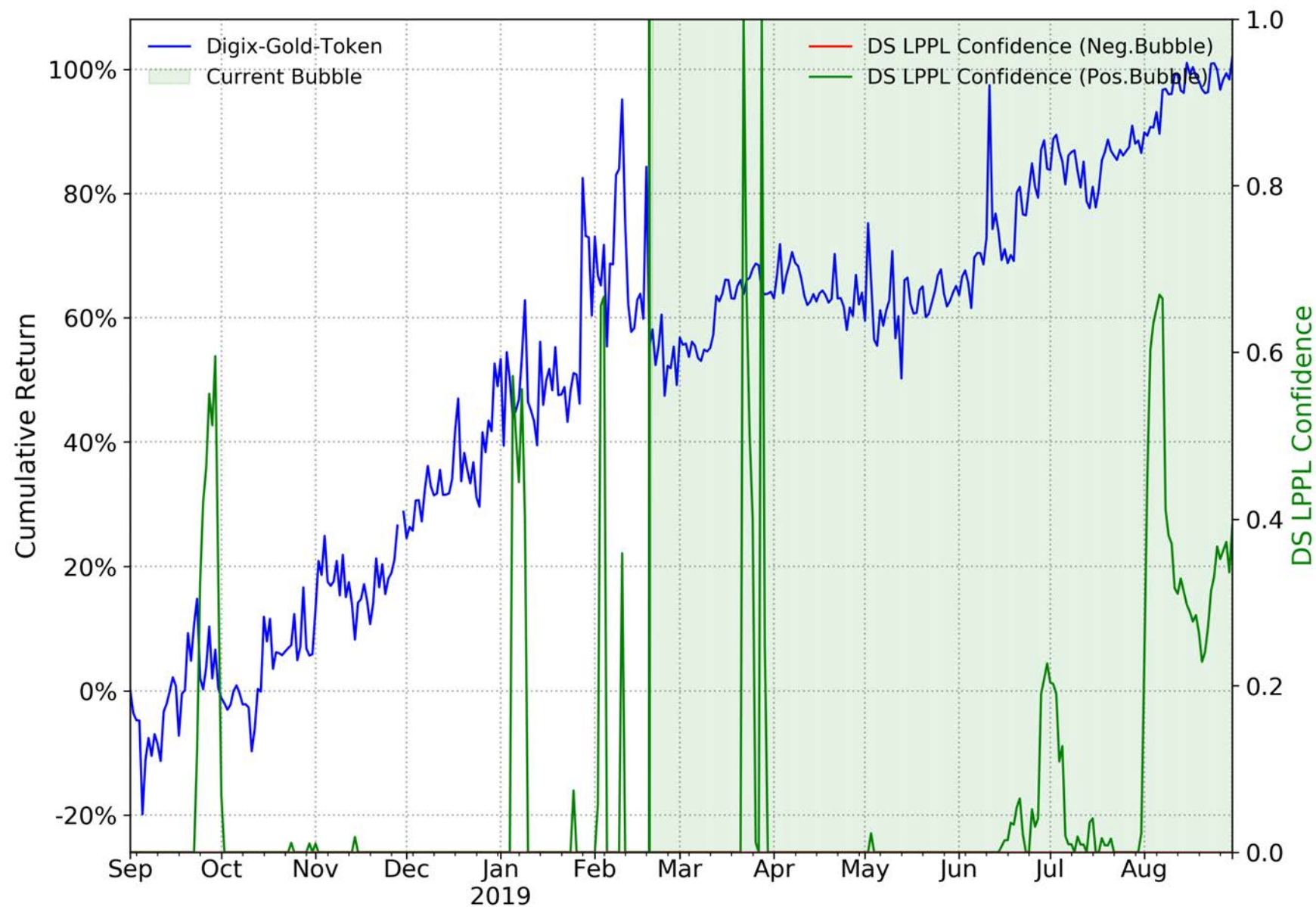
# Cryptocurrencies

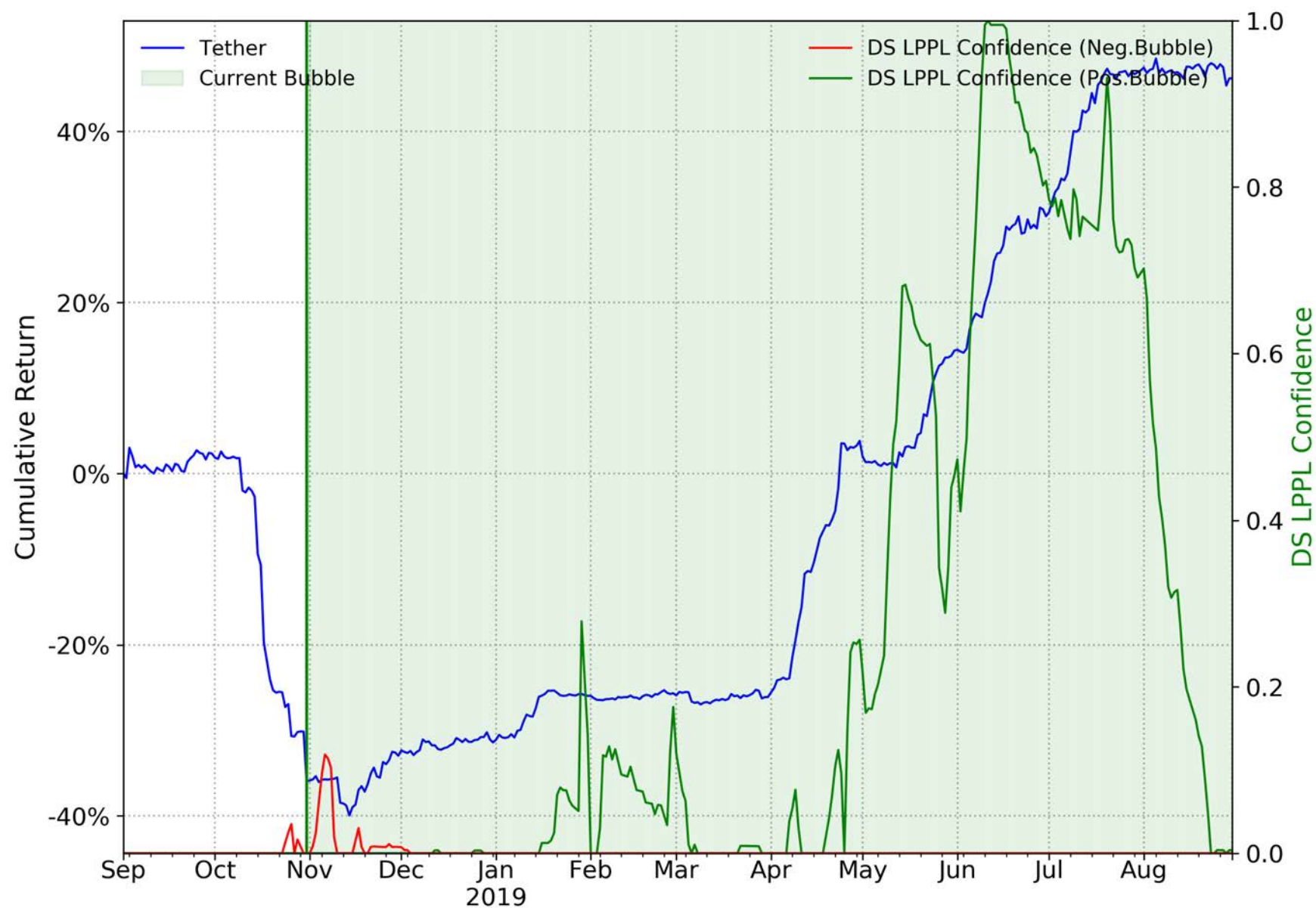
Bubble Data					Cluster Analysis				
	Name	Bubble Size <i>bs</i> [%]	Duration [ <i>days</i> ]	DS LPPL Confidence <i>ci</i> [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction $\mu_{t_c}$	$\sigma_{t_c}$ [ <i>days</i> ]	Scenario Probability [%]	
Positive Bubbles									
	1	Digix- Gold- Token	33	190	39	35	2019-09-03	2	50

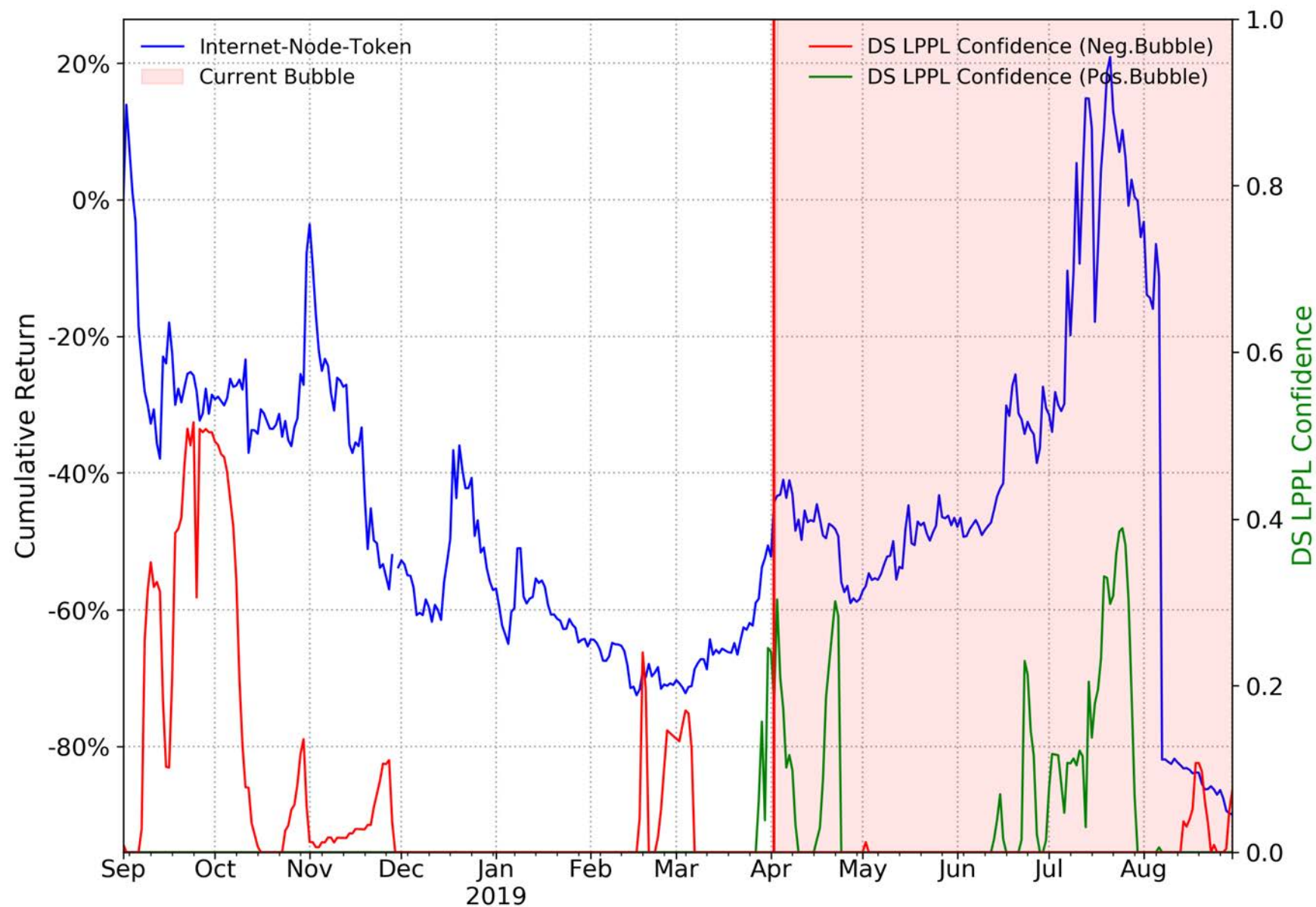
We find only a single cryptocurrency in a positive bubble state this month, Digix-Gold-Token. Interestingly, as the name reveals, the purpose of this digital currency is to provide ‘tokenization of physical assets’, namely gold. The webpage officially states that 1 DGX is equal to one gram of gold. Due to this link, simultaneously to the rising gold price, we observe evolving bubble activity on the DGX token market capitalization, at lower indicator (39% vs. 59%), but higher bubble size (33% vs. 17%) compared to the signals that we obtained for the aforementioned Gold Excess Return Index. This interesting tie between some digital currencies and their physical counterpart could be a useful additional piece of information when trying to evaluate whether a physical asset is in a bubble state or trying to value this asset in general.

On the next pages, we furthermore depict some of the previously listed cryptocurrencies. These have experienced corrections (in terms of market cap) in the meantime. Signals on Tether have sharply decreased, due to the sideways movements of market capitalization time series of the asset. We advise that the asset can still be seen to be in a market capitalization bubble.

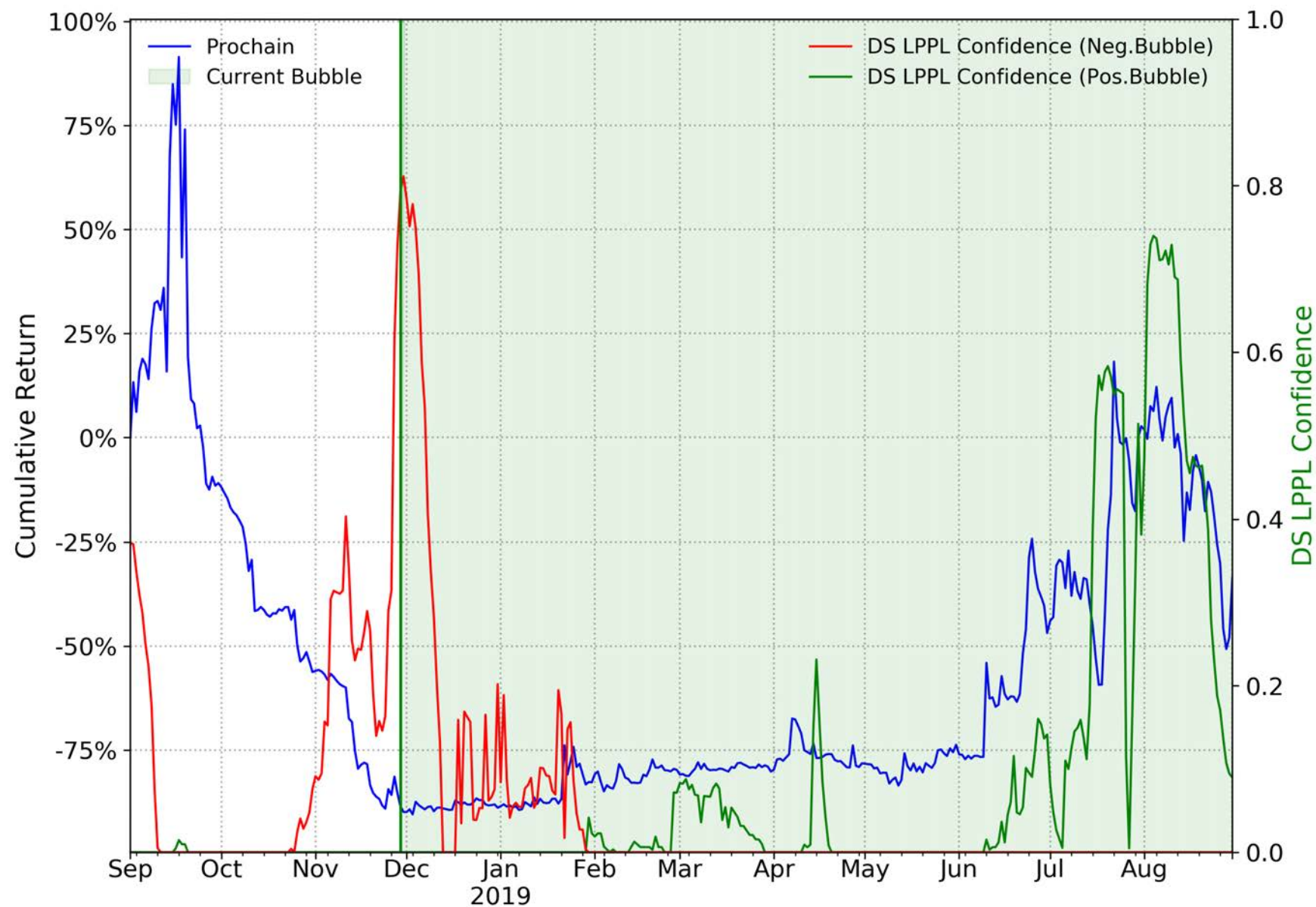












# Single Stocks

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.

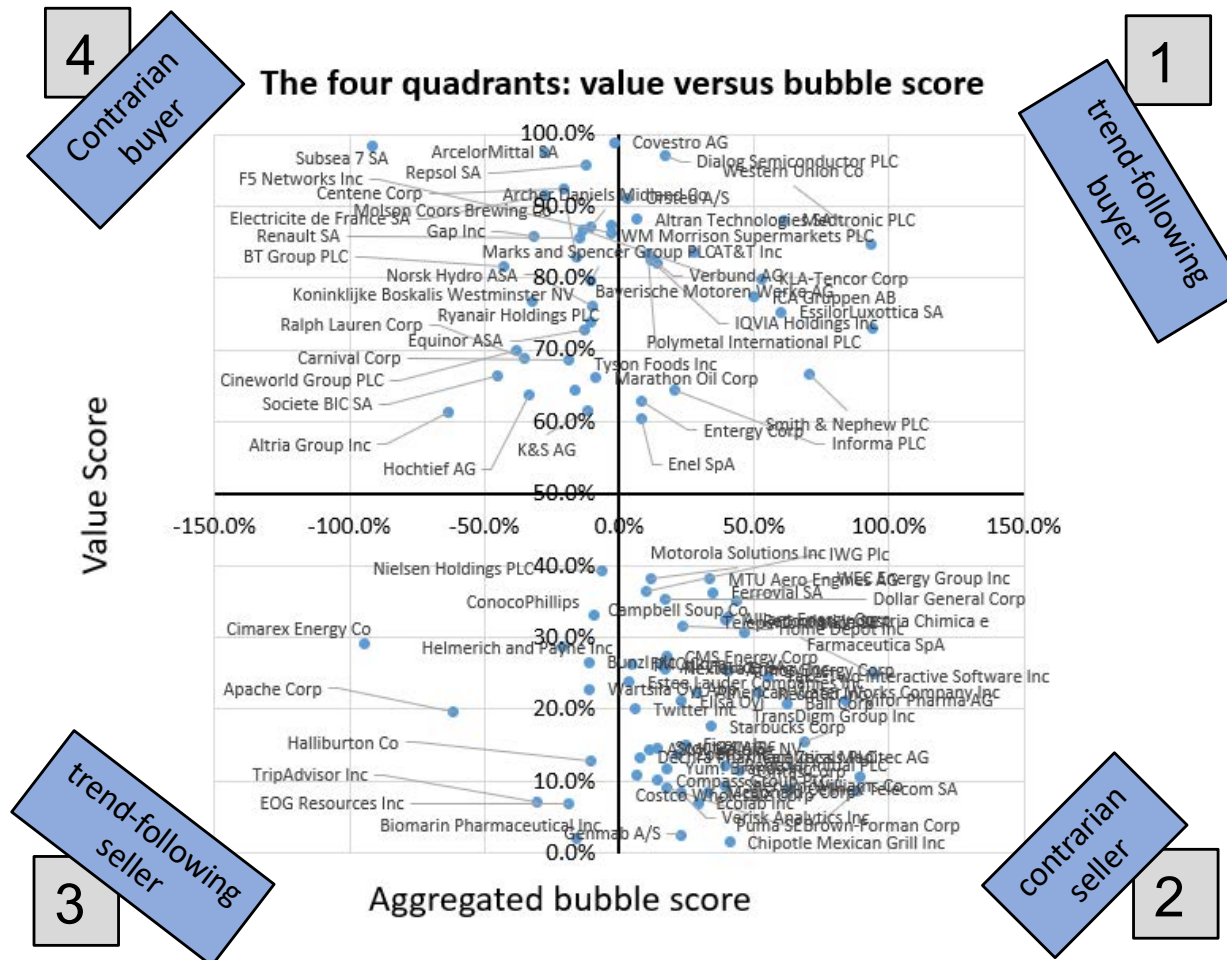
The stocks are the constituents of the Stoxx Europe 600, the S&P 500 and the Nasdaq 100 indices. From these, all doubles and stocks with incomplete data are removed. Because our financial strength indicators are specifically designed for corporates, all financial institutions are taken out of the set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



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. Ecolab Inc);
2. [Quadrant 2](#): Stocks with a strong positive bubble score and a weak value score (e.g. Centene Corp);
3. [Quadrant 3](#): Stocks with a strong negative bubble score and a weak value score (e.g. Gap Inc);
4. [Quadrant 4](#): Stocks with strong negative bubble score and a strong financial strength (e.g. Scout24 AG)

\*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)

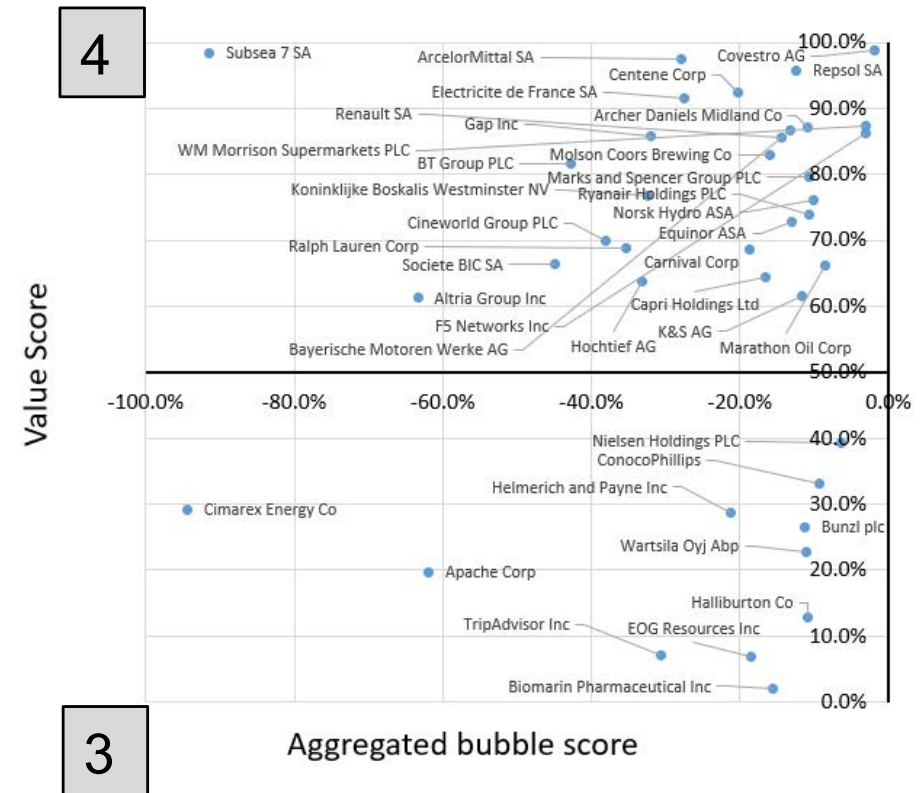
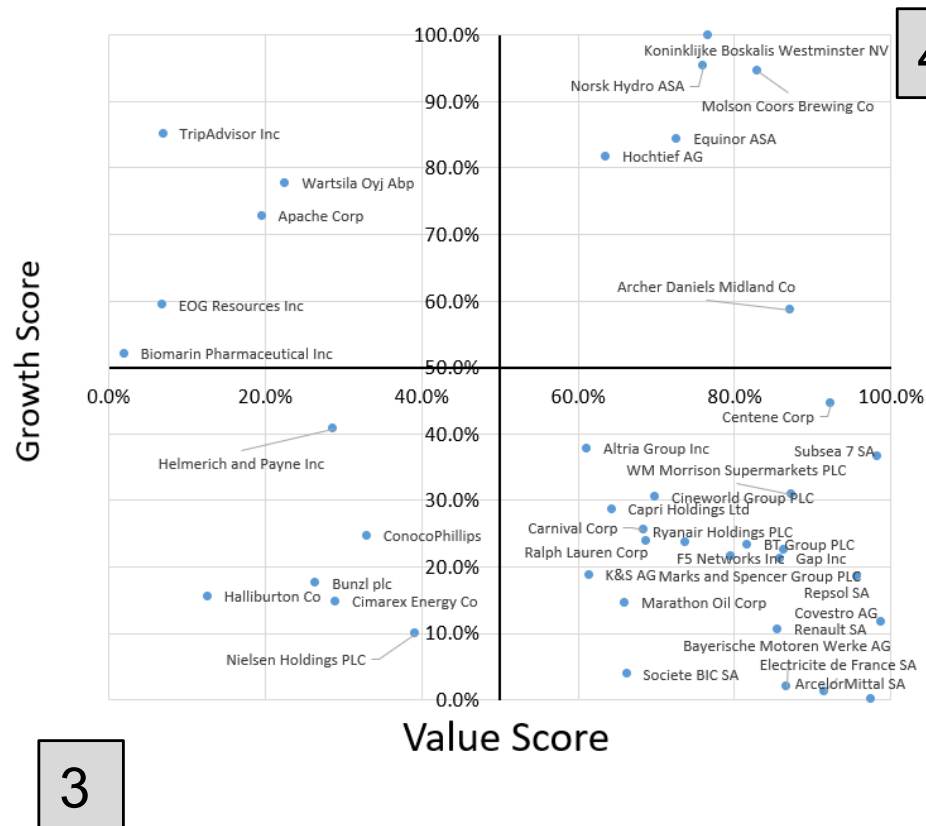
Strong positive bubble signals with strong (respectively weak) fundamentals



# Single Stocks

## Quadrants 3 and 4 (stocks)

Strong negative bubble signals with weak (respectively strong) fundamentals



# Single Stocks

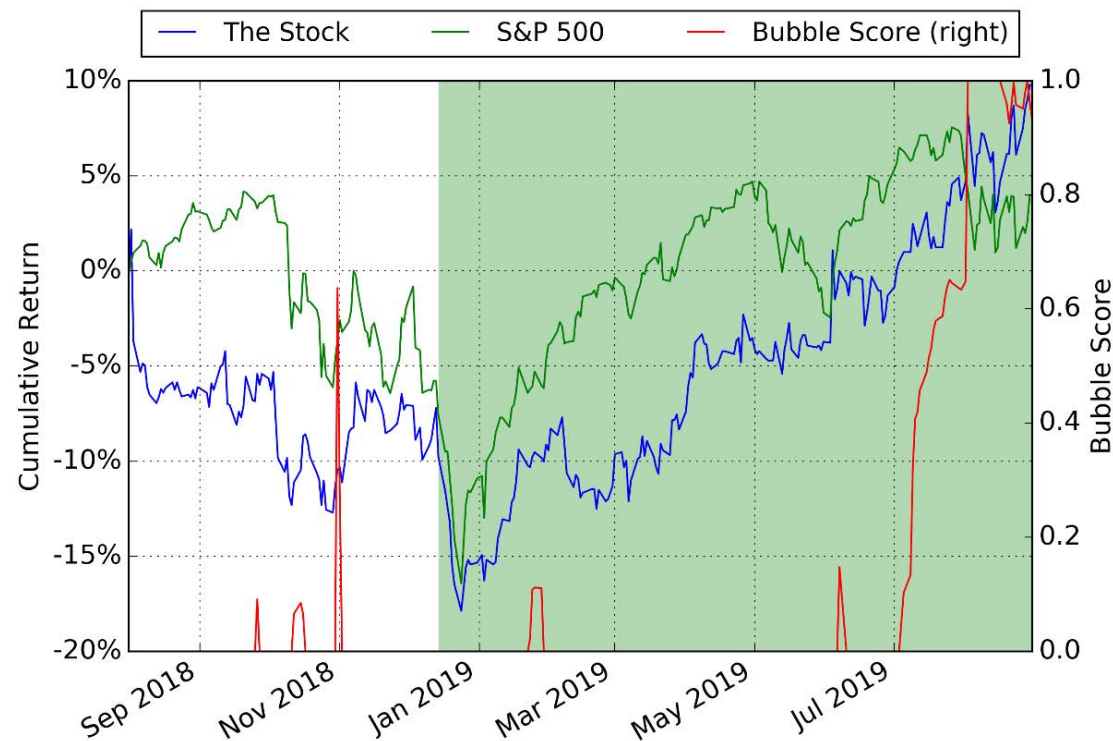
## Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Verbund AG	Austria	Utilities	42.7%	37.9%	Oct-18	13.9%	82.1%	29.3%
Orsted A/S	Denmark	Utilities	59.9%	45.1%	Nov-18	3.1%	91.2%	22.8%
Altran Technologies SA	France	Software & Services	86.0%	75.1%	Nov-18	6.5%	88.1%	18.4%
EssilorLuxottica SA	France	Consumer Durables & Apparel	11.3%	39.8%	Mar-19	60.0%	75.2%	32.7%
Smith & Nephew PLC	United Kingdom	Health Care Equipment & Services	42.1%	37.4%	Feb-19	70.3%	66.5%	16.4%
Dialog Semiconductor PLC	United Kingdom	Semiconductors & Semiconductor Equipment	123.8%	84.4%	Oct-18	17.2%	97.0%	5.6%
Informa PLC	United Kingdom	Media & Entertainment	15.2%	15.2%	Sep-18	20.5%	64.5%	34.8%
Medtronic PLC	Ireland; Republic of	Health Care Equipment & Services	12.0%	30.9%	Jan-19	61.0%	88.0%	47.3%
Enel SpA	Italy	Utilities	44.6%	31.4%	Dec-18	8.2%	60.5%	44.8%
Polymetal International PLC	Cyprus	Materials	97.2%	40.8%	Apr-19	94.2%	73.1%	32.8%
ICA Gruppen AB	Sweden	Food & Staples Retailing	77.4%	37.0%	Feb-19	50.0%	77.3%	72.2%
AT&T Inc	United States of America	Telecommunication Services	8.9%	19.4%	Jan-19	27.9%	83.6%	25.9%
Entergy Corp	United States of America	Utilities	32.5%	35.6%	Dec-18	8.1%	62.9%	17.2%
IQVIA Holdings Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	21.3%	21.3%	Sep-18	11.9%	82.4%	52.6%
KLA-Tencor Corp	United States of America	Semiconductors & Semiconductor Equipment	39.9%	70.1%	Dec-18	52.6%	79.9%	47.0%
Tyson Foods Inc	United States of America	Food, Beverage & Tobacco	46.8%	67.9%	43435	10.5%	83.3%	32.2%
Western Union Co	United States of America	Software & Services	15.6%	29.9%	43435	93.3%	84.6%	54.8%

# Single Stocks - Quadrant 1 stocks

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

Example: Western Union Co.

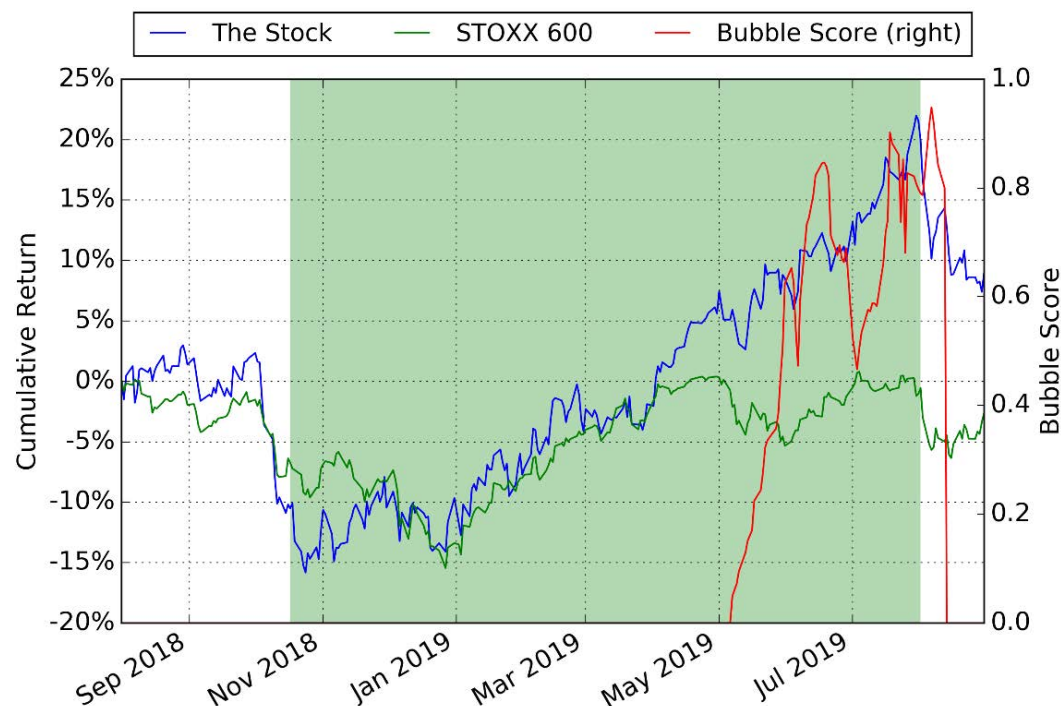


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this nine month bubble has reached 93.3% with a bubble size 29.9%.

# Single Stocks - Quadrant 1 stocks

**Last month example:** strong positive bubble signals with strong fundamentals, InterContinental Hotels Group PLC.

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. The stock had a strong correction in the past month, indicating the end of the previous bubble regime, which is in agreement with our DS LPPLS indicator, but in contradiction with the 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
Vifor Pharma AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	-8.5%	15.2%	Mar-19	84.1%	21.2%	93.6%
Carl Zeiss Meditec AG	Germany	Health Care Equipment & Services	37.8%	34.7%	Jan-19	89.1%	10.7%	57.2%
Puma SE	Germany	Consumer Durables & Apparel	60.8%	47.5%	Feb-19	88.2%	8.6%	78.2%
MTU Aero Engines AG	Germany	Capital Goods	33.0%	33.0%	Sep-18	33.7%	38.1%	21.9%
Scout24 AG	Germany	Media & Entertainment	21.0%	49.4%	Oct-18	14.0%	14.7%	52.8%
Genmab A/S	Denmark	Pharmaceuticals, Biotechnology & Life Sciences	32.7%	25.7%	Feb-19	22.8%	2.4%	21.3%
Cellnex Telecom SA	Spain	Telecommunication Services	73.6%	43.0%	Apr-19	63.1%	8.8%	81.2%
Ferrovial SA	Spain	Capital Goods	46.5%	27.0%	Mar-19	34.7%	36.1%	7.0%
Elisa Oyj	Finland	Telecommunication Services	22.4%	22.4%	Sep-18	23.2%	21.1%	19.8%
Teleperformance SE	France	Commercial & Professional Services	17.7%	35.1%	Jan-19	94.3%	25.0%	95.9%
Air Liquide SA	France	Materials	19.9%	18.6%	Nov-18	15.7%	25.9%	42.9%
Dechra Pharmaceuticals PLC	United Kingdom	Pharmaceuticals, Biotechnology & Life Sciences	22.7%	15.7%	Mar-19	7.4%	13.3%	52.4%
Rentokil Initial PLC	United Kingdom	Commercial & Professional Services	40.2%	28.3%	Feb-19	39.6%	12.1%	47.4%
Compass Group PLC	United Kingdom	Consumer Services	27.4%	22.9%	Feb-19	14.3%	10.1%	67.6%
Recordati Industria Chimica e Farmaceutica SpA	Italy	Pharmaceuticals, Biotechnology & Life Sciences	30.5%	11.8%	Mar-19	46.4%	30.7%	76.8%
IWG Plc	Switzerland	Commercial & Professional Services	78.8%	81.4%	Oct-18	10.0%	36.5%	79.8%
ASML Holding NV	Netherlands	Semiconductors & Semiconductor Equipment	26.2%	26.2%	Oct-18	10.9%	14.3%	32.6%
Alliant Energy Corp	United States of America	Utilities	19.8%	24.2%	Sep-18	39.2%	32.4%	69.8%
American Water Works Company Inc	United States of America	Utilities	43.6%	46.9%	Sep-18	28.8%	22.3%	66.4%
Atmos Energy Corp	United States of America	Utilities	18.5%	18.5%	Sep-18	40.3%	25.5%	55.6%
Ball Corp	United States of America	Materials	86.2%	67.1%	Jan-19	62.1%	20.8%	49.3%
Brown-Forman Corp	United States of America	Food, Beverage & Tobacco	16.3%	24.8%	Jan-19	17.6%	9.1%	61.2%
CMS Energy Corp	United States of America	Utilities	24.7%	30.7%	Dec-18	17.5%	27.3%	70.9%

# Single Stocks - Quadrant 2 stocks

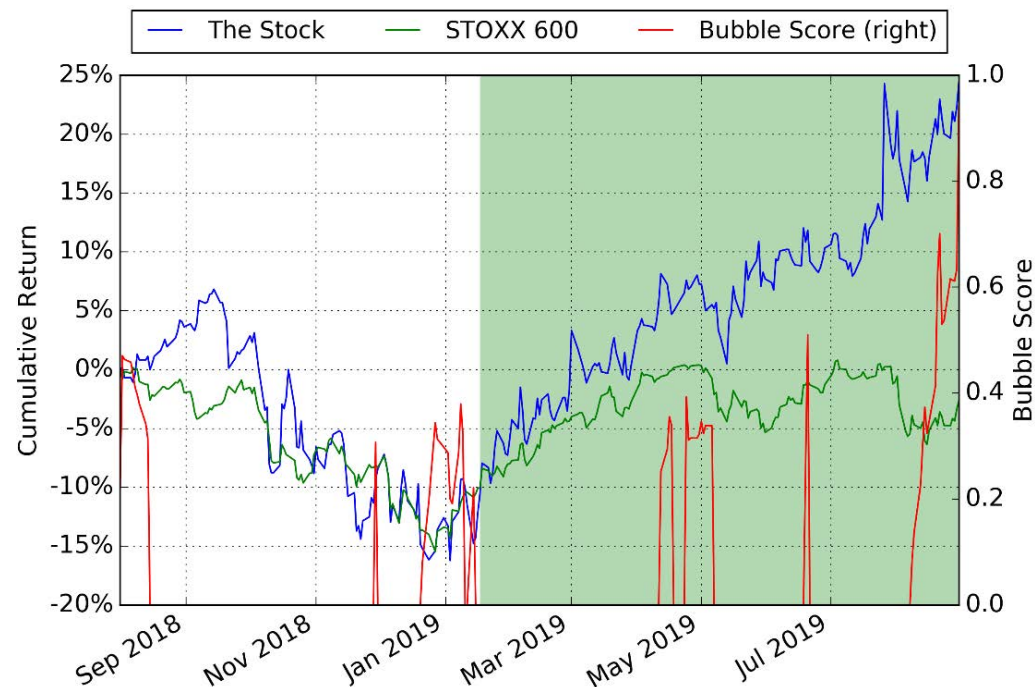
## Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Campbell Soup Co	United States of America	Food, Beverage & Tobacco	11.0%	28.4%	Jan-19	40.8%	33.0%	28.7%
Chipotle Mexican Grill Inc	United States of America	Consumer Services	71.4%	43.1%	Feb-19	40.8%	1.5%	53.9%
Cintas Corp	United States of America	Commercial & Professional Services	23.0%	52.9%	Jan-19	44.4%	11.4%	61.1%
Costco Wholesale Corp	United States of America	Food & Staples Retailing	21.2%	42.9%	Jan-19	6.3%	10.9%	67.0%
Dollar General Corp	United States of America	Retailing	40.1%	45.2%	Oct-18	16.9%	35.4%	66.2%
Ecolab Inc	United States of America	Materials	34.1%	26.2%	Feb-19	29.1%	6.8%	69.5%
FMC Corp	United States of America	Materials	21.3%	18.1%	Oct-18	4.7%	26.3%	24.7%
Fiserv Inc	United States of America	Software & Services	33.0%	33.0%	Sep-18	24.4%	15.0%	69.7%
Home Depot Inc	United States of America	Retailing	8.2%	28.7%	Jan-19	23.5%	31.6%	50.3%
Estee Lauder Companies Inc	United States of America	Household & Personal Products	42.9%	31.8%	Feb-19	3.8%	23.8%	49.5%
Mcdonald's Corp	United States of America	Consumer Services	32.0%	34.2%	Sep-18	32.7%	8.5%	43.8%
Motorola Solutions Inc	United States of America	Technology Hardware & Equipment	42.3%	51.3%	Oct-18	11.9%	38.2%	43.5%
Nextera Energy Inc	United States of America	Utilities	27.3%	30.3%	Dec-18	17.1%	25.7%	75.2%
Resmed Inc	United States of America	Health Care Equipment & Services	24.4%	47.3%	Jan-19	51.9%	22.2%	63.3%
Sherwin-Williams Co	United States of America	Materials	12.8%	24.7%	43525	39.6%	9.3%	53.1%
Starbucks Corp	United States of America	Consumer Services	75.7%	75.7%	43344	34.2%	17.6%	63.4%
Take-Two Interactive Software Inc	United States of America	Media & Entertainment	2.2%	48.8%	43497	55.0%	24.5%	12.5%
TransDigm Group Inc	United States of America	Capital Goods	60.3%	36.4%	43497	68.4%	15.5%	57.0%
Twitter Inc	United States of America	Media & Entertainment	39.7%	34.1%	43374	6.0%	20.0%	26.8%
Verisk Analytics Inc	United States of America	Commercial & Professional Services	33.6%	33.6%	43344	22.6%	8.4%	70.7%
WEC Energy Group Inc	United States of America	Utilities	38.6%	41.6%	43435	43.3%	35.0%	57.6%
Yum! Brands Inc	United States of America	Consumer Services	32.0%	24.9%	43497	17.7%	11.6%	86.9%
Zoetis Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	42.3%	33.9%	43497	21.8%	13.7%	60.6%

# Single Stocks - Quadrant 2 stocks

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

Example: Teleperformance SE.

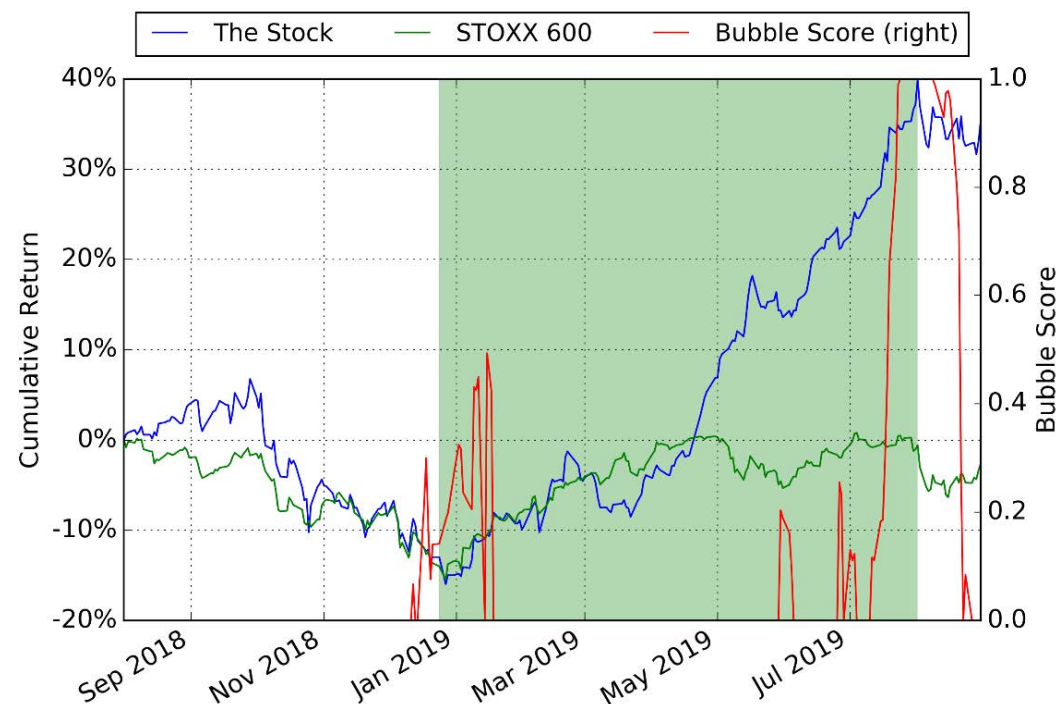


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the positive bubble we identified. The Bubble Score of this eight month bubble has reached 94.3% with a bubble size 35.1%. 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, AAK AB (publ).

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 has started a strong correction after reaching the peak at the beginning of the past month, which is in agreement with the weak fundamentals and our DS LPPLS indicator.



# Single Stocks - Quadrant 3 stocks

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

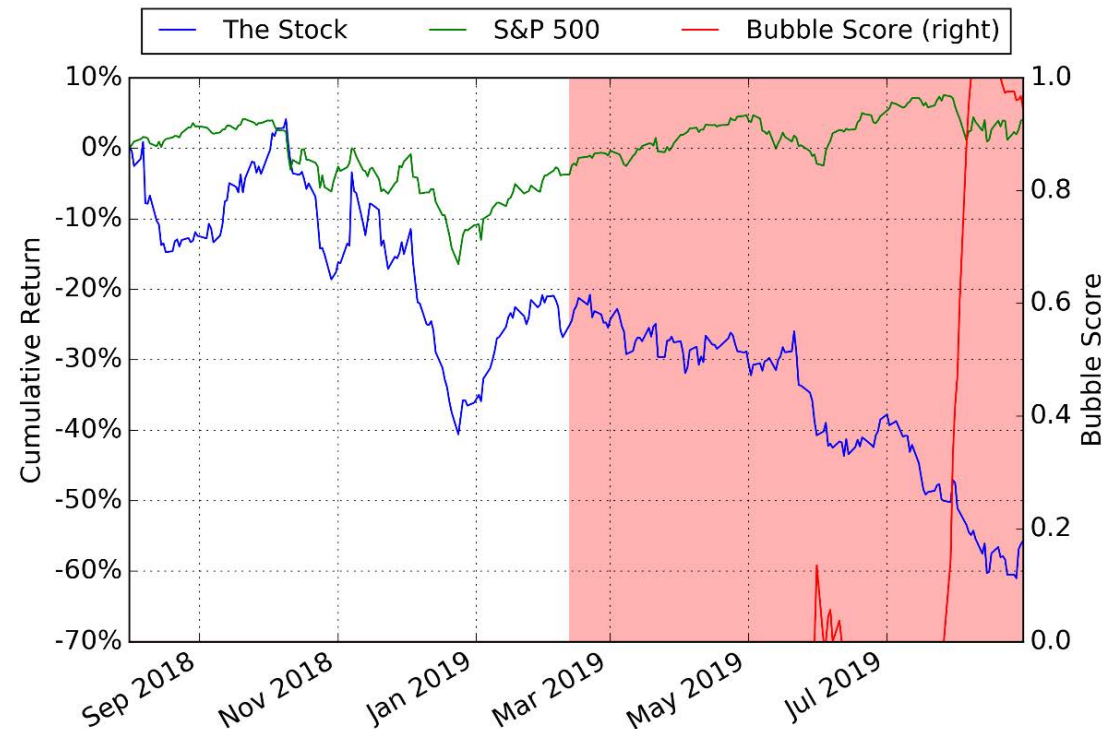
Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Wartsila Oyj Abp	Finland	Capital Goods	-33.1%	-22.5%	Mar-19	-11.0%	22.7%	77.7%
Bunzl plc	United Kingdom	Capital Goods	-15.5%	-12.4%	Oct-18	-11.3%	26.5%	17.5%
Nielsen Holdings PLC	United States of America	Commercial & Professional Services	-21.9%	-24.1%	Sep-18	-6.4%	39.3%	9.9%
Apache Corp	United States of America	Energy	-50.2%	-30.6%	Jan-19	-61.9%	19.6%	72.7%
Biomarin Pharmaceutical Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	-23.0%	-23.0%	Sep-18	-15.6%	2.1%	52.0%
Cimarex Energy Co	United States of America	Energy	-49.4%	-42.9%	Feb-19	-94.4%	29.1%	14.7%
ConocoPhillips	United States of America	Energy	-26.7%	-29.7%	Sep-18	-9.4%	33.1%	24.6%
EOG Resources Inc	United States of America	Energy	-35.1%	-33.2%	Oct-18	-18.6%	6.9%	59.3%
Halliburton Co	United States of America	Energy	-48.7%	-53.0%	Sep-18	-10.8%	12.7%	15.5%
Helmerich and Payne Inc	United States of America	Energy	-40.7%	-29.8%	Jan-19	-21.2%	28.7%	40.7%
TripAdvisor Inc	United States of America	Media & Entertainment	-25.0%	-34.2%	43435	-30.7%	7.0%	85.1%



# Single Stocks - Quadrant 3 stocks

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

Example: Cimarex Energy Co.

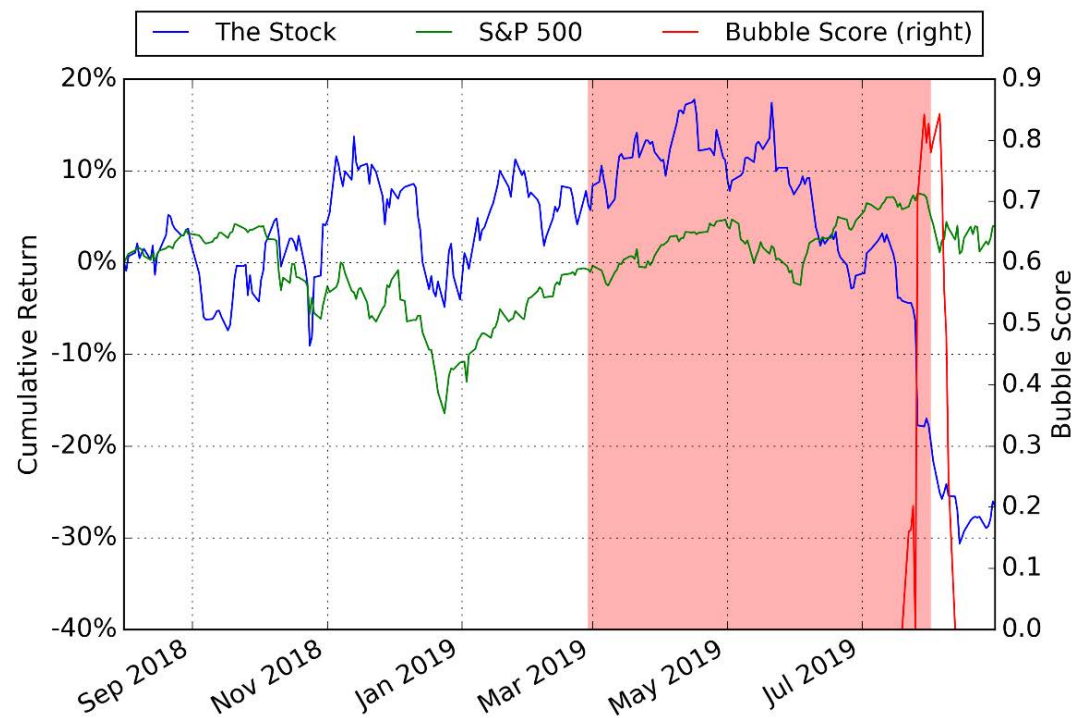


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the negative bubble we identified. The Bubble Score of this six month bubble has reached 94.4% with a bubble size -42.9%.

# Single Stocks - Quadrant 3 stocks

**Last month example:** strong negative bubble signals with weak fundamentals, Cabot Oil & Gas Corp.

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 price remains at a low level, which seems to have stabilized in the last month, which is in agreement with the DS LPPLS indicator. The stabilization of the price at a low level is in line with the weak fundamentals.



# Single Stocks - Quadrant 4 stocks

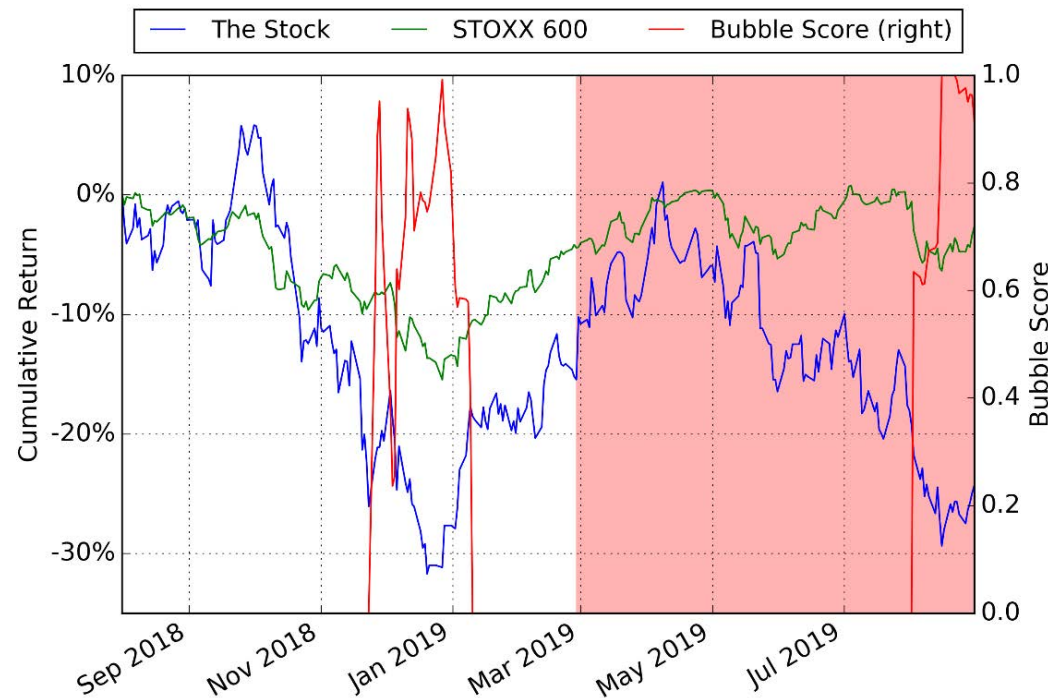
## Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Bayerische Motoren Werke AG	Germany	Automobiles & Components	-25.0%	-23.1%	Sep-18	-13.3%	86.7%	1.9%
Covestro AG	Germany	Materials	-40.7%	-9.2%	Jan-19	-1.8%	98.8%	11.6%
Hochtief AG	Germany	Capital Goods	-28.9%	-29.8%	Sep-18	-33.3%	63.6%	81.7%
K&S AG	Germany	Materials	-22.0%	-15.0%	Mar-19	-11.6%	61.5%	18.7%
Repsol SA	Spain	Energy	-15.7%	-10.7%	Oct-18	-12.4%	95.8%	18.5%
Societe BIC SA	France	Commercial & Professional Services	-23.6%	-37.9%	Dec-18	-45.0%	66.3%	3.8%
Renault SA	France	Automobiles & Components	-27.5%	-14.7%	Jan-19	-14.4%	85.6%	10.5%
Electricite de France SA	France	Utilities	-25.5%	-21.3%	Dec-18	-27.5%	91.5%	1.1%
WM Morrison Supermarkets PLC	United Kingdom	Food & Staples Retailing	-31.4%	-20.3%	Dec-18	-3.0%	87.4%	30.9%
BT Group PLC	United Kingdom	Telecommunication Services	-25.9%	-24.7%	Feb-19	-42.7%	81.7%	23.3%
Marks and Spencer Group PLC	United Kingdom	Retailing	-31.3%	-31.3%	Jan-19	-10.6%	79.5%	21.6%
Cineworld Group PLC	United Kingdom	Media & Entertainment	-26.8%	-19.5%	Mar-19	-38.0%	69.9%	30.4%
Ryanair Holdings PLC	Ireland; Republic of	Transportation	-30.7%	-29.9%	Sep-18	-10.7%	73.8%	23.6%
Subsea 7 SA	United Kingdom	Energy	-18.6%	-15.7%	Feb-19	-91.4%	98.3%	36.6%
ArcelorMittal SA	Luxembourg	Materials	-47.7%	-49.5%	Sep-18	-27.8%	97.5%	0.0%
Koninklijke Boskalis Westminster NV	Netherlands	Capital Goods	-26.0%	-31.3%	Sep-18	-32.3%	76.7%	99.9%
Norsk Hydro ASA	Norway	Materials	-39.1%	-28.8%	Jan-19	-10.1%	76.0%	95.4%
Equinor ASA	Norway	Energy	-25.8%	-21.3%	Feb-19	-13.1%	72.7%	84.4%
Carnival Corp	United States of America	Consumer Services	-28.9%	-14.8%	Mar-19	-18.7%	68.5%	25.6%
Altria Group Inc	United States of America	Food, Beverage & Tobacco	-27.8%	-20.0%	Mar-19	-63.4%	61.2%	37.7%
Archer Daniels Midland Co	United States of America	Food, Beverage & Tobacco	-23.4%	-11.7%	Jan-19	-10.8%	87.2%	58.5%
Centene Corp	United States of America	Health Care Equipment & Services	-35.0%	-35.0%	Sep-18	-20.3%	92.4%	44.5%
F5 Networks Inc	United States of America	Technology Hardware & Equipment	-32.7%	-32.6%	Oct-18	-3.0%	86.3%	22.4%
Gap Inc	United States of America	Retailing	-45.4%	-43.0%	Sep-18	-31.9%	85.8%	21.2%
Marathon Oil Corp	United States of America	Energy	-41.8%	-23.2%	Jan-19	-8.6%	66.1%	14.5%
Molson Coors Brewing Co	United States of America	Food, Beverage & Tobacco	-20.7%	-19.3%	Jan-19	-16.0%	82.9%	94.5%
Ralph Lauren Corp	United States of America	Consumer Durables & Apparel	-33.6%	-28.8%	Feb-19	-35.3%	68.7%	23.9%
Capri Holdings Ltd	United Kingdom	Consumer Durables & Apparel	-64.0%	-64.0%	43344	-16.6%	64.4%	28.6%

# Single Stocks - Quadrant 4 stocks

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

Example: Subsea 7 SA.

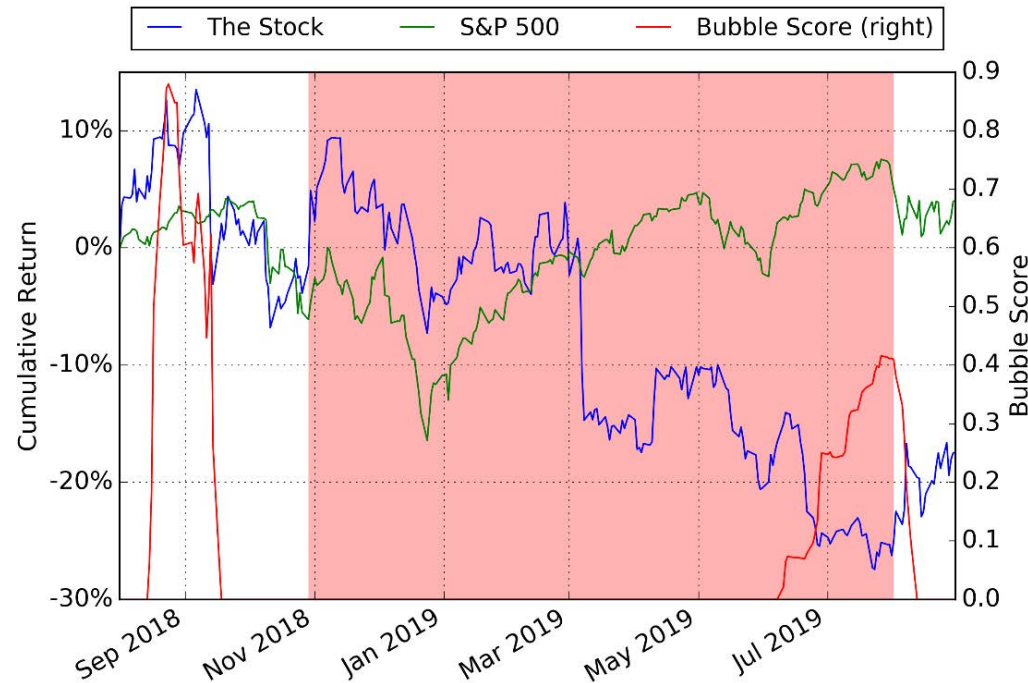


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this six month bubble has reached 91.4% with a bubble size -15.7%. 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, Kroger Co.

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 in the past month, which is in agreement with our DS LPPLS indicator, and the strong fundamentals lead us to expect future increase in the price.





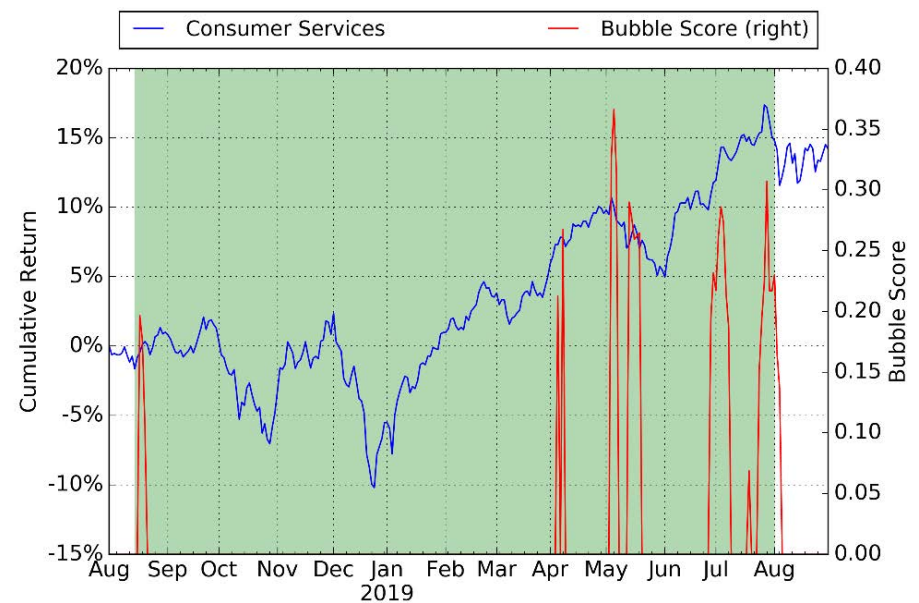
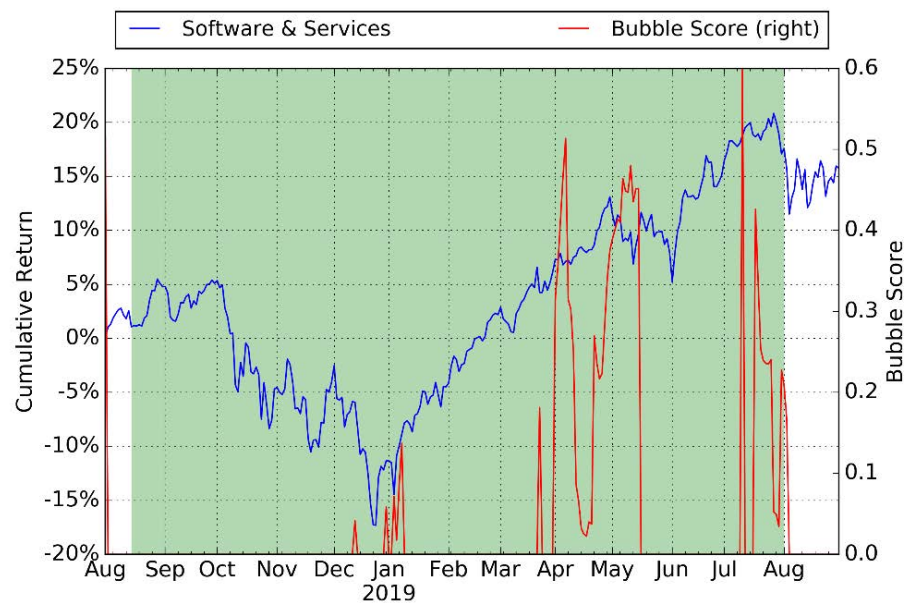
# Sectors

GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	Sep 1st	Aug 1st	Sep 1st	Aug 1st	Sep 1st	Aug 1st	Sep 1st	Aug 1st	Sep 1st	Aug 1st
Pharmaceuticals, Biotechnology & Life Sciences	-3.0%	-0.5%	0.0%	0.0%	0.0%	0.0%	70.6%	70.0%	50.8%	50.3%
Consumer Services	14.6%	16.7%	0.0%	16.7%	0.0%	23.0%	31.8%	32.4%	49.1%	49.0%
Retailing	-3.4%	2.5%	0.0%	0.0%	0.0%	0.0%	19.7%	19.3%	55.9%	55.2%
Transportation	-3.2%	0.6%	0.0%	0.0%	0.0%	0.0%	54.8%	55.0%	49.5%	49.6%
Consumer Durables & Apparel	-2.2%	2.5%	0.0%	0.0%	0.0%	0.0%	32.9%	33.5%	56.5%	55.9%
Semiconductors & Semiconductor Equipment	4.4%	4.7%	0.0%	0.0%	0.0%	0.0%	62.2%	62.7%	33.8%	33.1%
Technology Hardware & Equipment	-6.4%	2.0%	0.0%	0.0%	0.0%	0.0%	57.9%	63.9%	42.3%	43.0%
Automobiles & Components	-12.5%	-11.0%	0.0%	0.0%	0.0%	0.0%	74.4%	73.5%	56.8%	57.7%
Telecommunication Services	-0.6%	0.5%	0.0%	0.0%	0.0%	0.0%	65.0%	64.0%	42.4%	42.1%
Energy	-20.1%	-13.3%	0.0%	0.0%	0.0%	0.0%	54.5%	54.0%	49.1%	49.9%
Software & Services	11.5%	16.3%	0.0%	16.3%	0.0%	20.8%	35.1%	36.7%	46.8%	46.6%
Materials	-5.2%	-0.8%	0.0%	0.0%	0.0%	0.0%	54.9%	53.8%	50.2%	47.0%
Health Care Equipment & Services	1.2%	7.4%	0.0%	0.0%	0.0%	0.0%	60.5%	60.5%	49.9%	49.9%
Capital Goods	-5.7%	0.1%	0.0%	0.0%	0.0%	0.0%	50.1%	49.7%	48.7%	48.3%
Media & Entertainment	14.7%	19.7%	0.0%	0.0%	0.0%	0.0%	28.9%	29.1%	44.1%	44.5%
Commercial & Professional Services	9.3%	13.6%	0.0%	0.0%	0.0%	0.0%	30.1%	30.6%	52.3%	52.0%
Food & Staples Retailing	4.3%	3.3%	0.0%	0.0%	0.0%	0.0%	49.8%	51.8%	53.2%	52.8%
Household & Personal Products	17.6%	15.7%	0.0%	0.0%	0.0%	0.0%	33.1%	30.1%	47.5%	46.0%
Food, Beverage & Tobacco	5.7%	5.3%	0.0%	0.0%	0.0%	0.0%	46.8%	46.5%	53.4%	53.9%
Utilities	11.7%	10.2%	0.0%	0.0%	0.0%	0.0%	51.5%	51.3%	44.8%	44.6%
Insurance	3.0%	8.2%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Real Estate	10.1%	7.8%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Diversified Financials	-4.7%	-0.5%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Banks	-13.8%	-9.1%	0.0%	0.0%	0.0%	0.0%	-	-	-	-

# Sectors

We use 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 0 industry groups with a positive bubble score. The 2 industry groups that we identified last month with a positive bubble score are plotted below.



# 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.

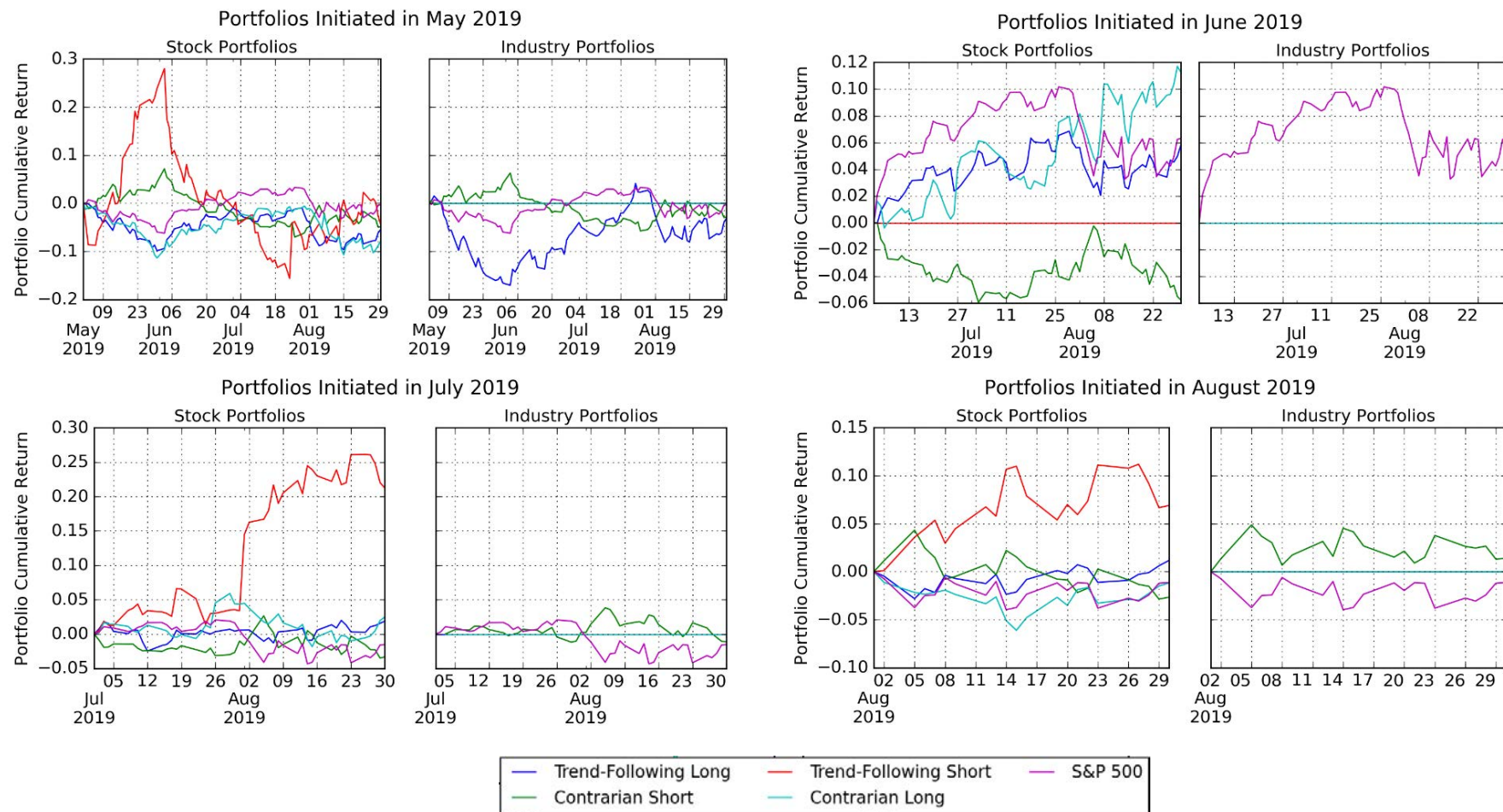
# Portfolio Construction & Performance

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.



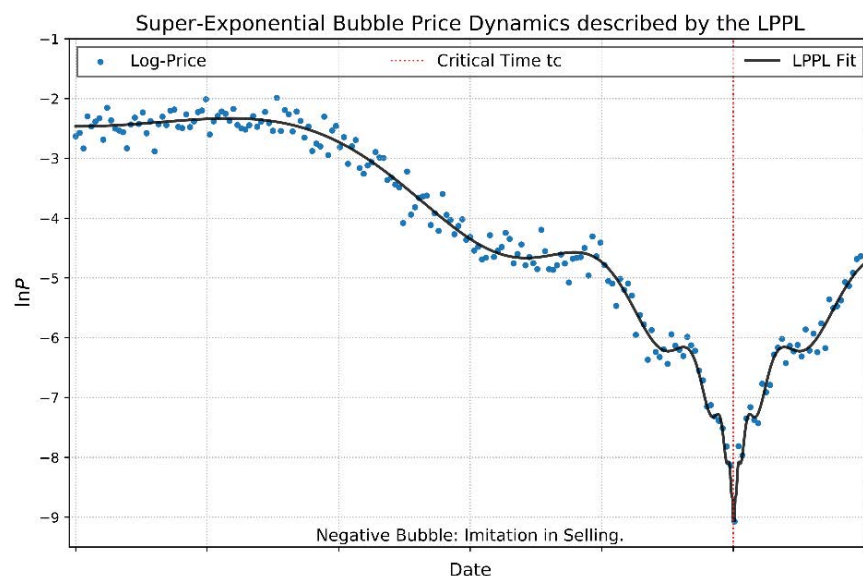
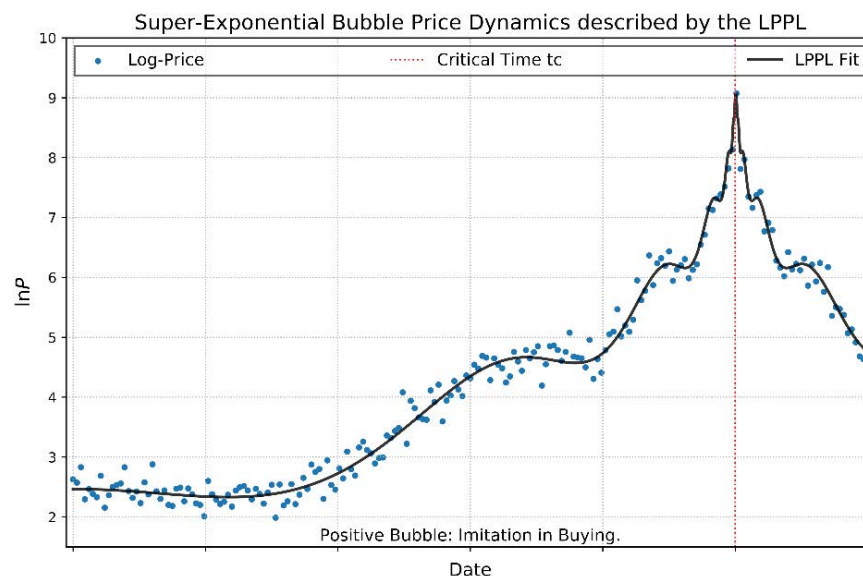
# Appendix

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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:

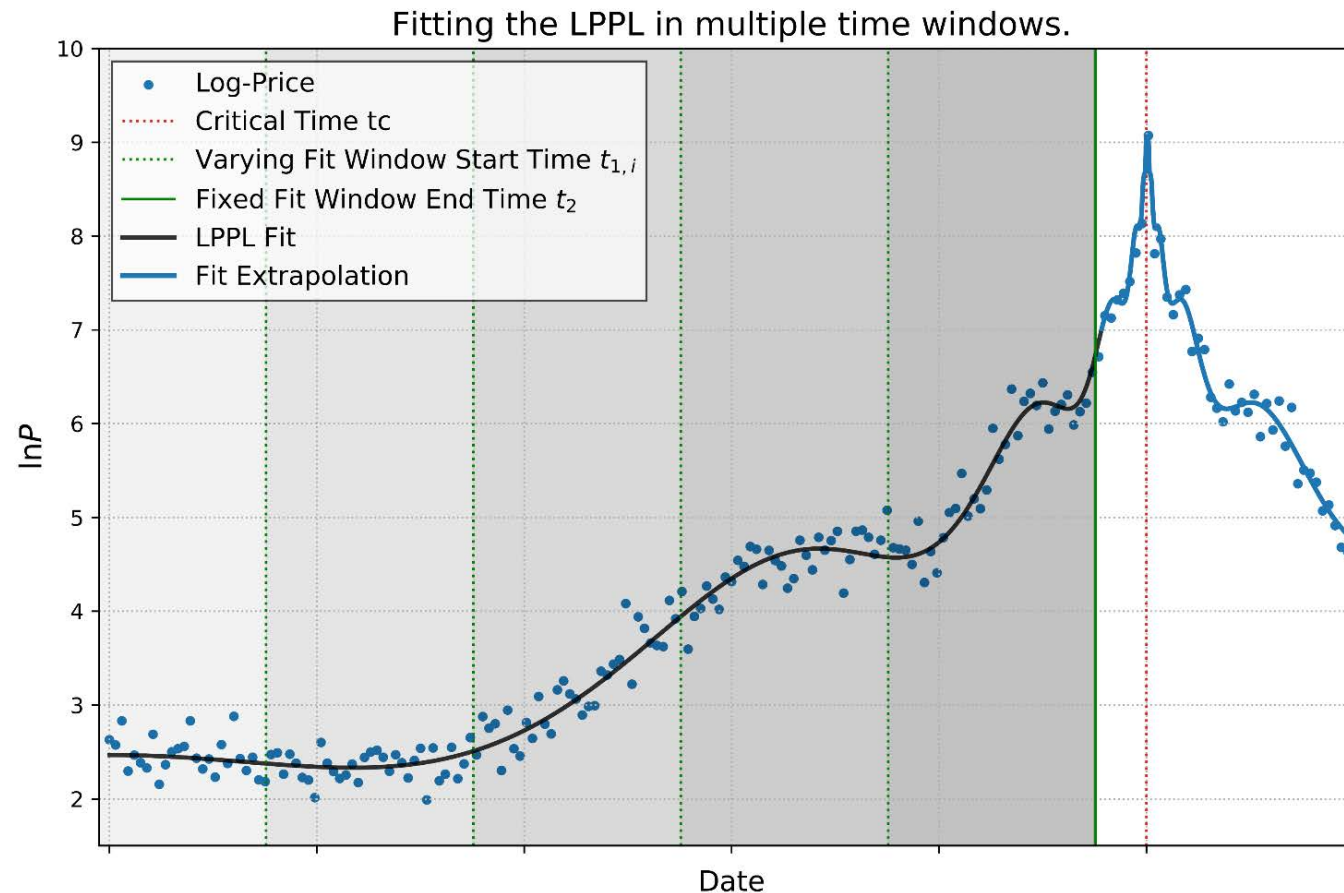
$$LPPLS := E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$

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.

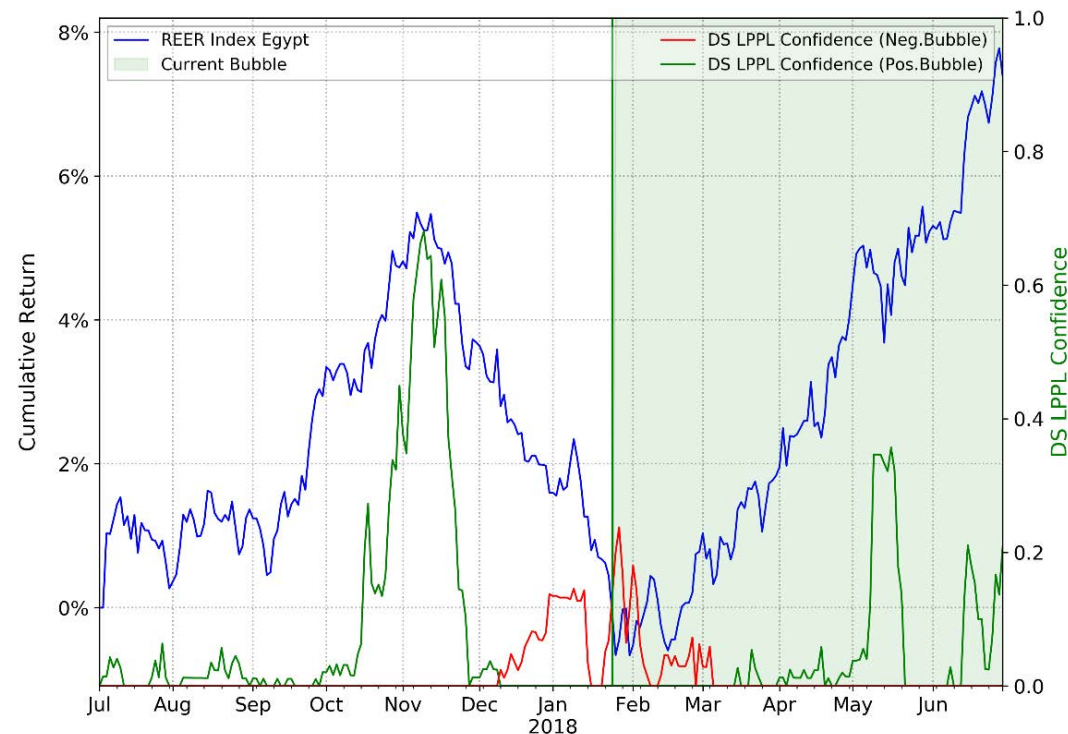
The first section provides asset and estimated bubble characteristics (size and duration), as well as the value of the confidence indicator. We rank assets according to their geometric average of the absolute of bubble size and confidence indicator. In this way, we incorporate the bubble size into the 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.



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).

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