The FCO Cockpit
Global Bubble Status Report

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About

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

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

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

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

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

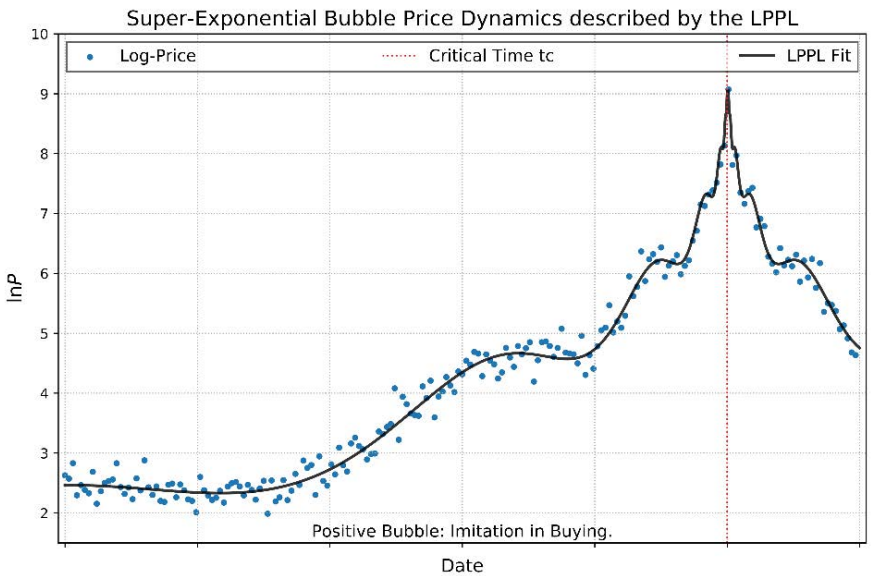
Methodology

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

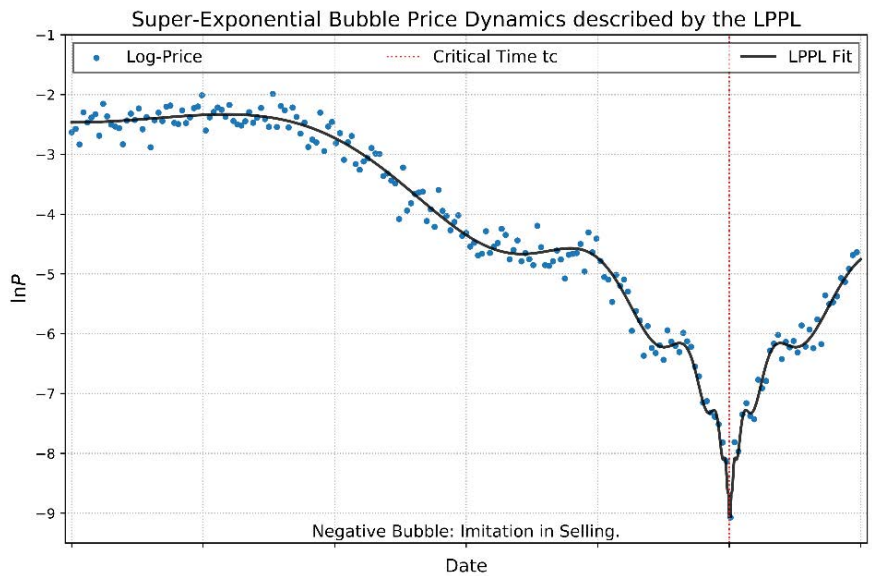
1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.
2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in volatility towards the end of the bubble.
3. At the end of the bubble, the so-called critical time t_c, a finite time singularity occurs after which the bubble bursts.

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

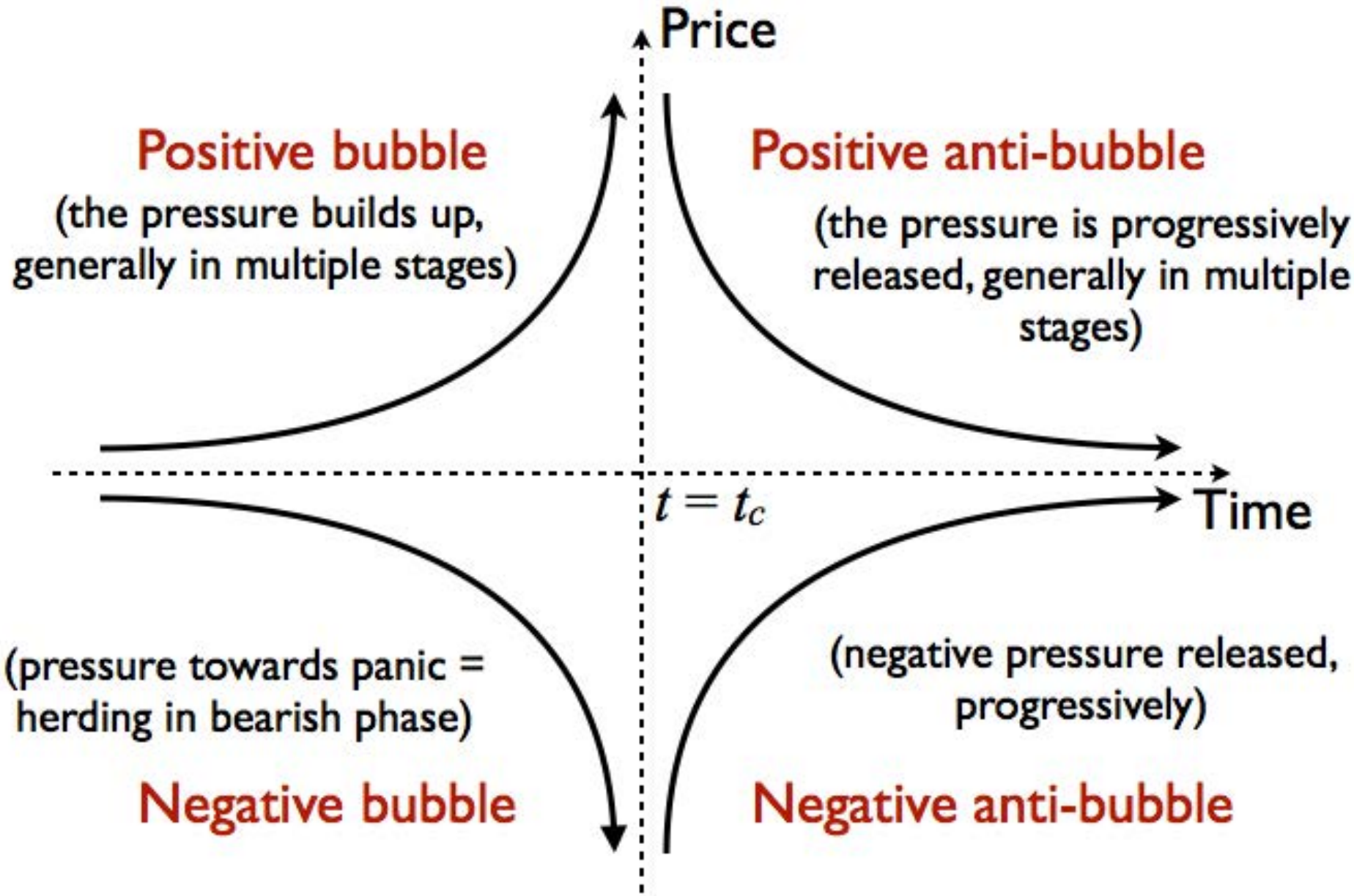
Positive bubble



Negative bubble



Summary of the four regimes before and after a market regime change at t_c



General Results – The Big Picture

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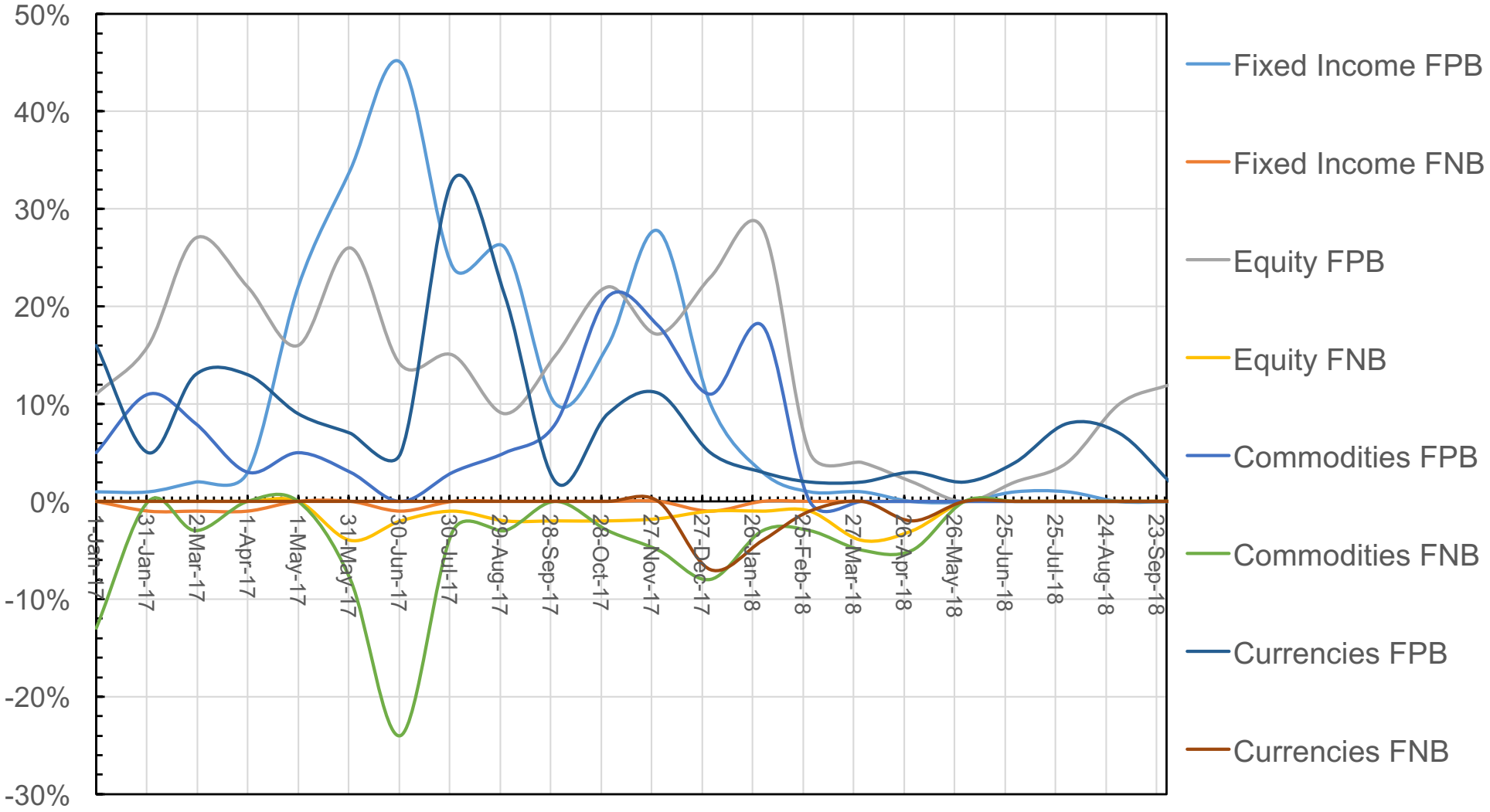
Historical evolution of the fraction of assets within an asset class that show significant bubble signals



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

General Results – October 2018 Overview

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Category	Analyzed Assets	Fraction of Pos. Bubbles [%]	Fraction of Neg. Bubbles [%]
Fixed Income	155	0	0
Government Bonds	55	0	0
Finance and Insurance	21	0	0
Corporate Bonds	79	0	0
Equity	292	12	0
Country Indices	61	3	0
Europe	31	0	0
United States	200	16	0
Commodities	30	0	0
Forex	50	2	0

At the beginning of October, we see a small increase in the fraction of detected positive bubble signals (from 10% to 12%) amongst the analysed assets within the Equities sector.

The commodities and fixed income sectors remain at all-zero levels.

In the forex sector, we report a decrease of positive bubble activity from 7% to 2%. The cryptocurrency sector remains silent, as well.

Equities – Country Indices

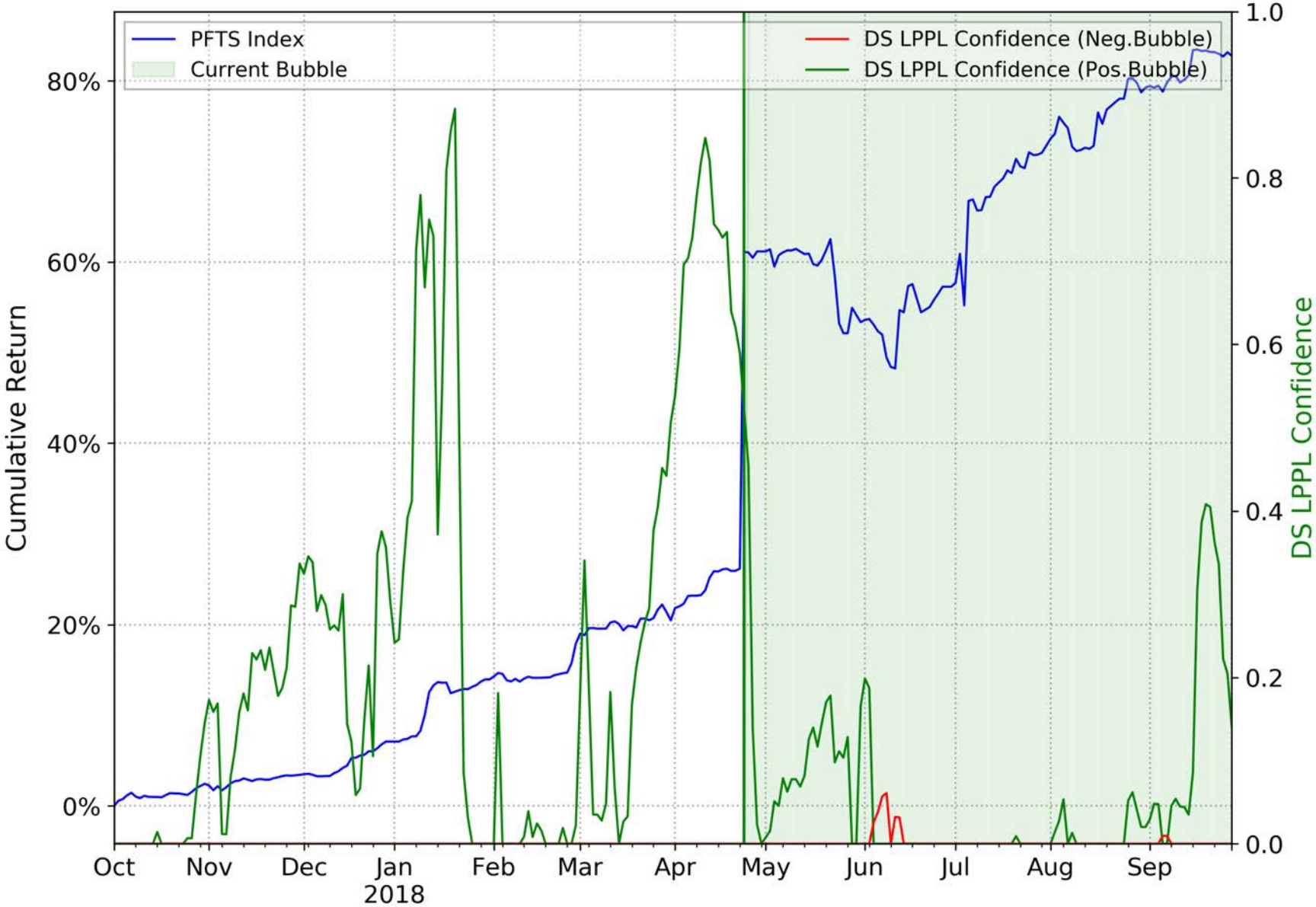
	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	PFTS Index	13	156	43	24	2018-09-28		33
2	Dow Jones Composite Index	12	189	27	18	2018-09-29	2	61

As in the previous month, for the country equity indices, we report a fraction of positive bubble signals of 3%. This amounts to two indices that show signs of bubble activity.

Firstly, at the top of our table, we see the Ukrainian PFTS index, that has appeared in past reports, as well. See the corresponding plot of the indicator series on the next slide for a more detailed analysis.

Furthermore, the Dow Jones Composite appears in the list, at a confidence indicator value of 27% and an estimated bubble size of 12%.

In last month's summary, we reported the (correlated) CNX Nifty and BSE Sensex indices to be in a positive bubble. We can now see on the following slides that the peak of this bubble has been reached and a drop has occurred throughout September.


PFTS Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
80%
60%
40%
20%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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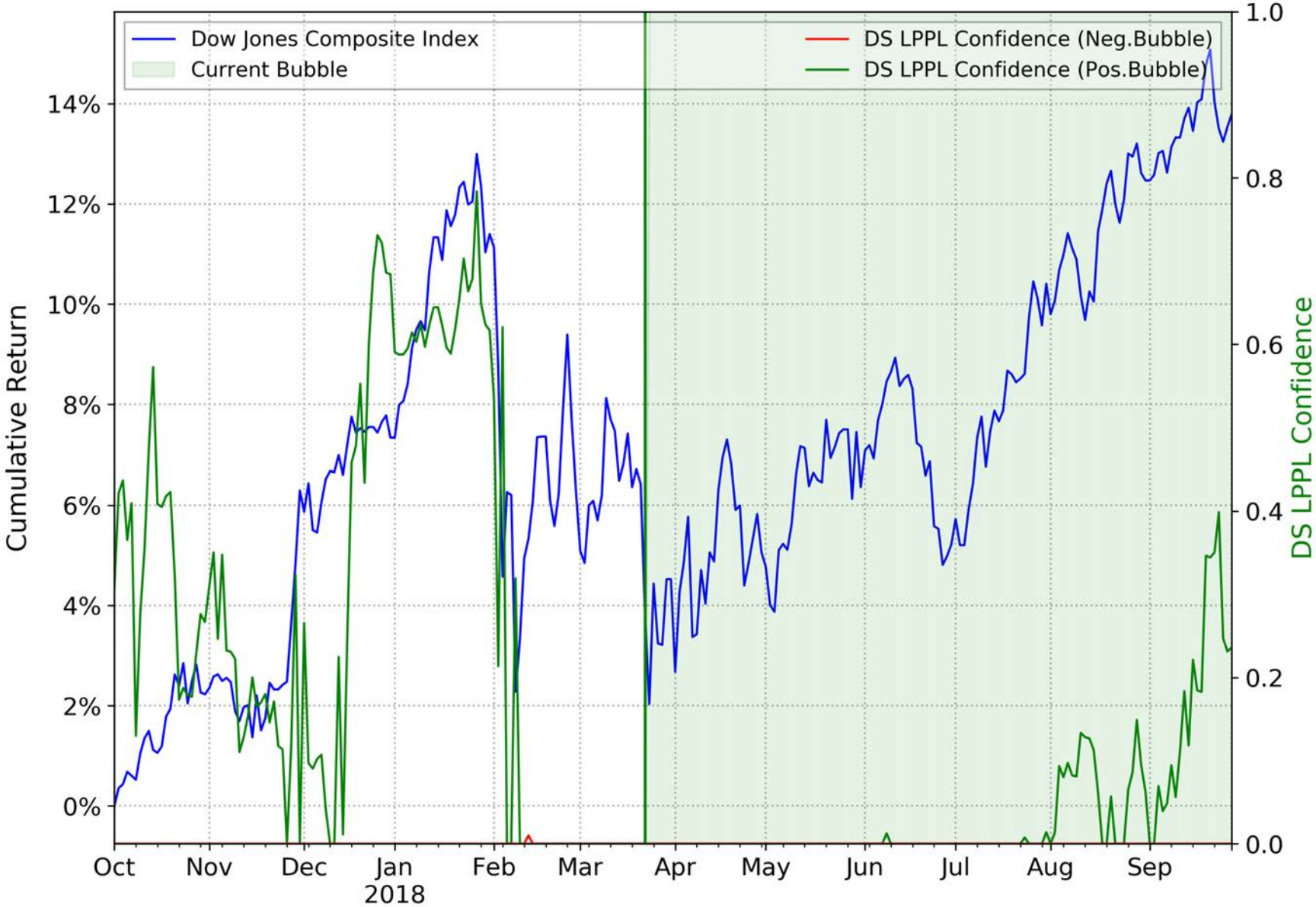
Dow Jones Composite Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
14%
12%
10%
8%
6%
4%
2%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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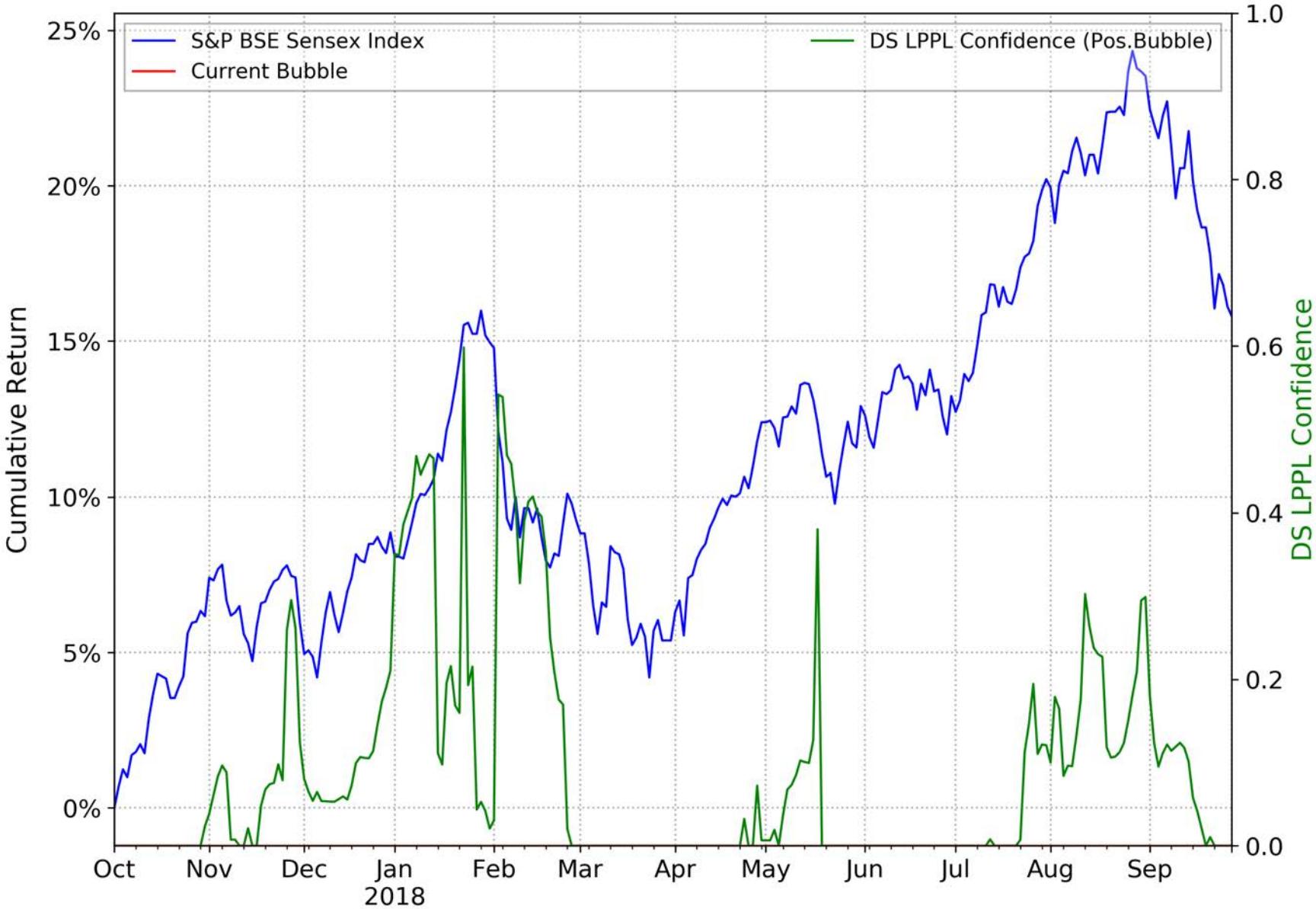
S&P BSE Sensex Index
Current Bubble
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
25%
20%
15%
10%
5%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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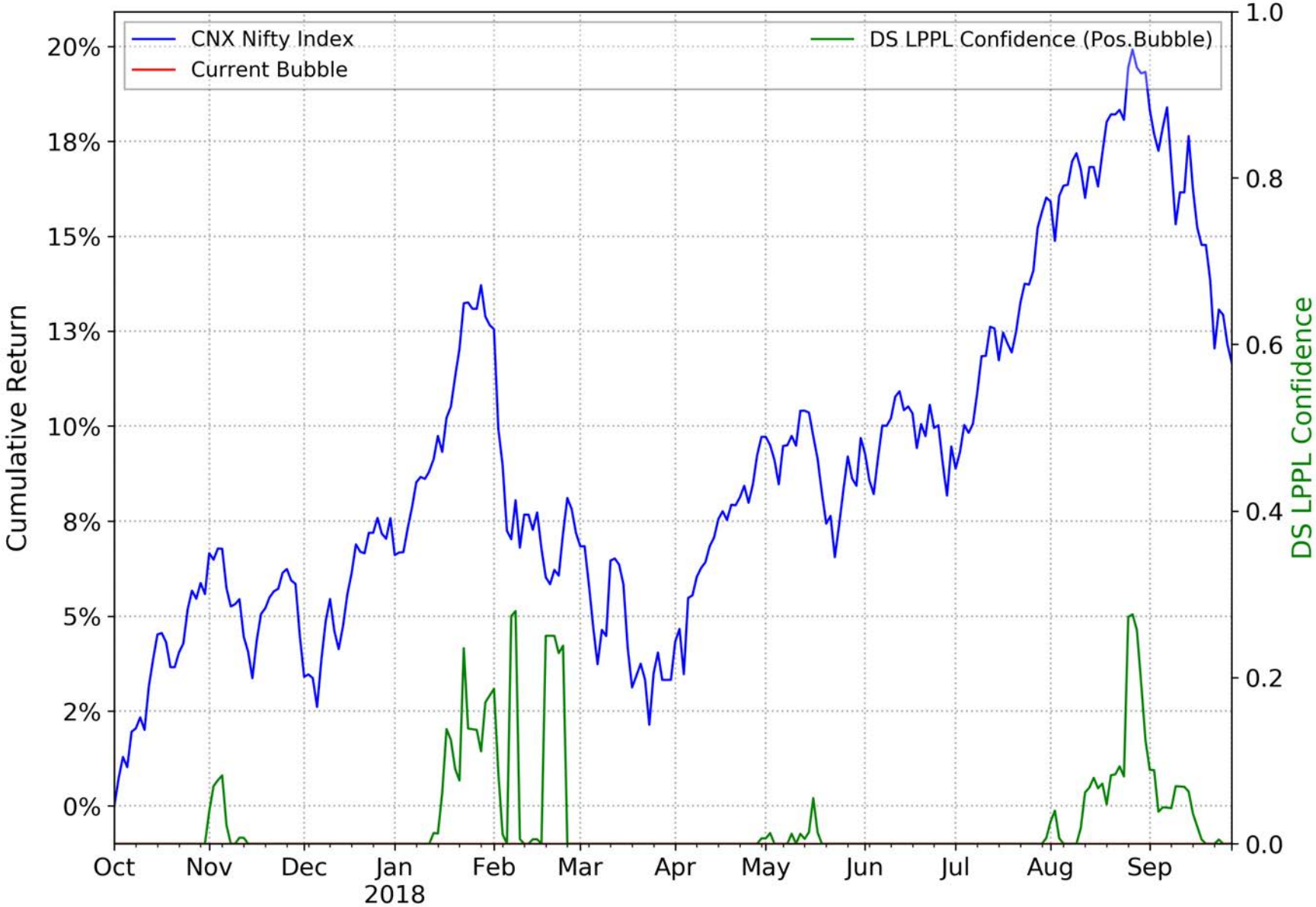
CNX Nifty Index
Current Bubble
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
20%
18%
15%
13%
10%
8%
5%
2%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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Equities - United States

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	S&P500 Railroads	25	225	54	36	2018-10-28	2	39
2	S&P500 Consumer Electronics	21	189	42	30	2018-09-28		20
3	S&P500 Construction & Engineering	21	147	32	26	2018-10-08	2	70
4	S&P500 Construction & Engineer Si	21	147	32	26	2018-10-08	2	70
5	S&P500 Health Care Prov & Serv	16	201	43	26	2018-10-04	5	48
6	S&P500 Health Care Equip & Serv	18	195	34	25	2018-10-01	2	68
7	S&P 500 COMPOSITE	13	189	43	23	2018-10-23	13	87
8	S&P 500 Cad Hdg	12	189	41	22	2018-10-23	13	91
9	S&P500 Data Pro&Out Svs	14	141	35	22	2018-09-28		53
10	S&P 500 Gbp Hdg	12	189	40	22	2018-10-22	13	93

Again, the United States Equities sector shows the highest positive bubble activity amongst equities sectors. As in the previous reports, bubble signatures are identified in a variety of S&P500 sub-indices. Most critical time predictions in the list are again close to the present time, a fact that indicates short-term price acceleration. Confidence indicators range between 32%-54%, bubble sizes between 12%-25% and the geometric averages of the two between 22%-36%. Analysis plots for the top three indices are available on the next slides.


S&P500 Railroads
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
40%
30%
20%
10%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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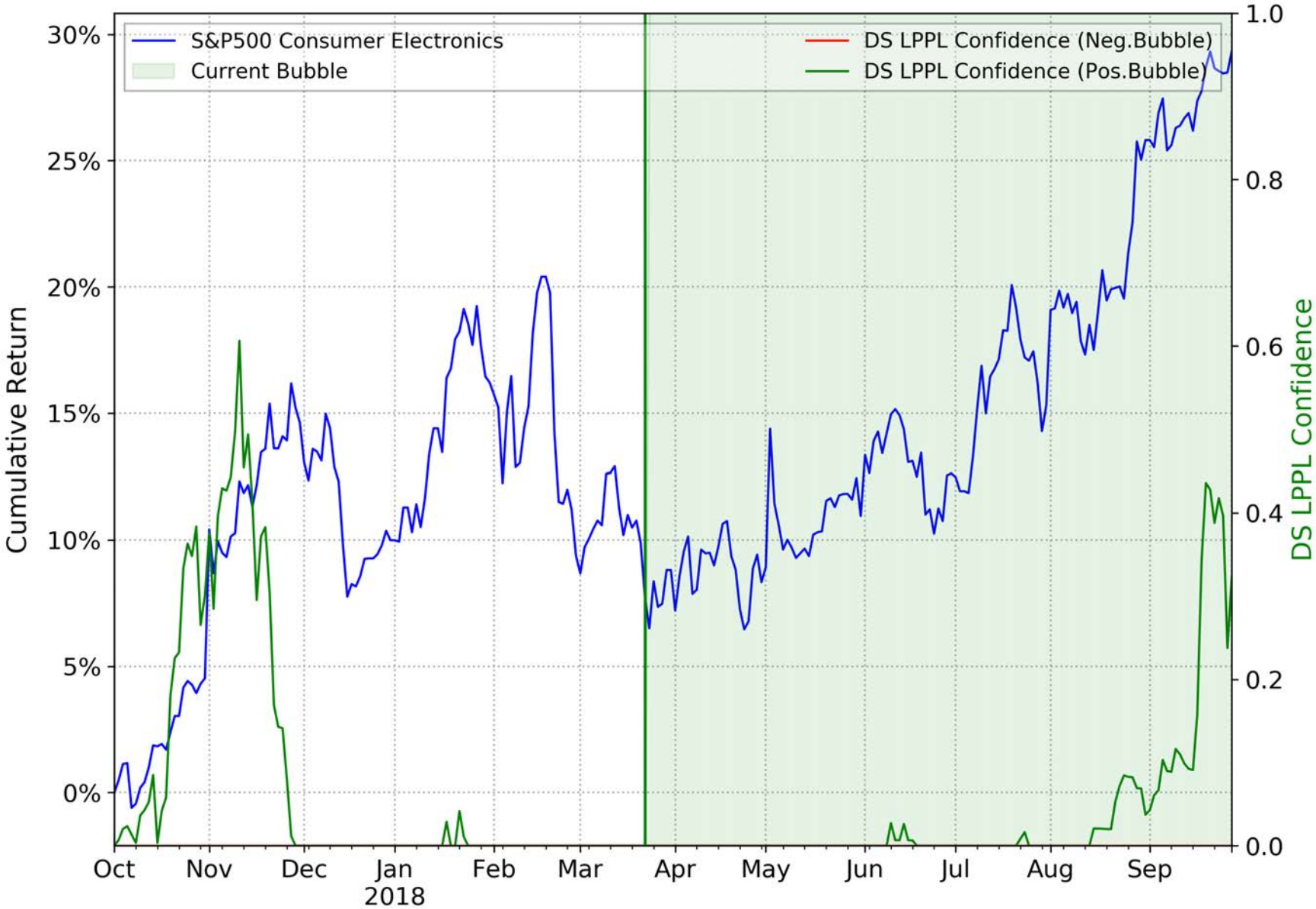
S&P500 Consumer Electronics
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
30%
25%
20%
15%
10%
5%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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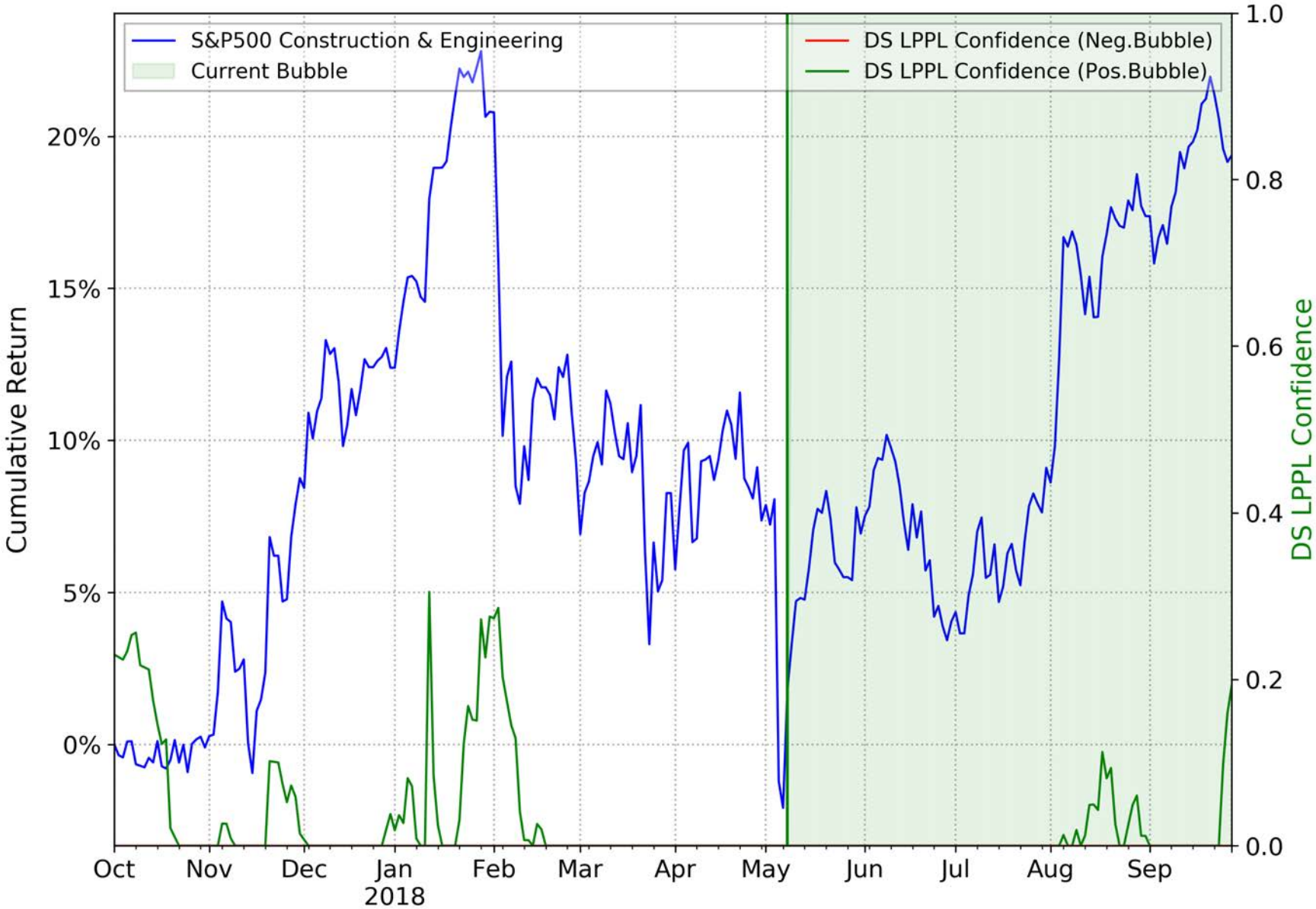
S&P500 Construction & Engineering
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
20%
15%
10%
5%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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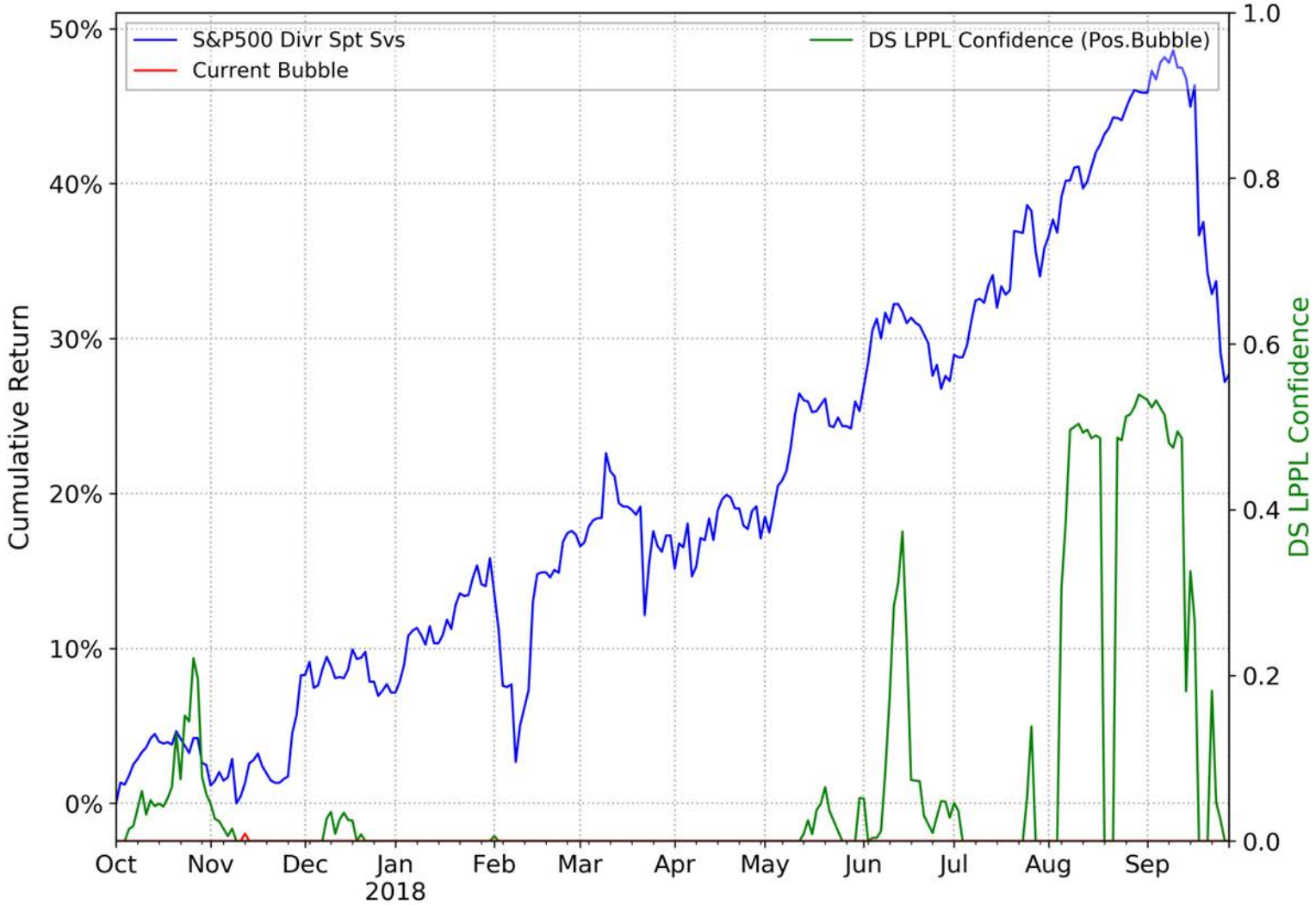


We additionally show this US equity sub-index which has been listed amongst the top three positive bubble signals in the previous report. It has undergone an impressive crash of about 20% during the last month. Moreover, there still seems to be even more downward momentum in the price movement.

Currencies – Real Effective Exchange Rates & PCA

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	REER Index Singapore	11	237	76	29	2018-09-29	2	64

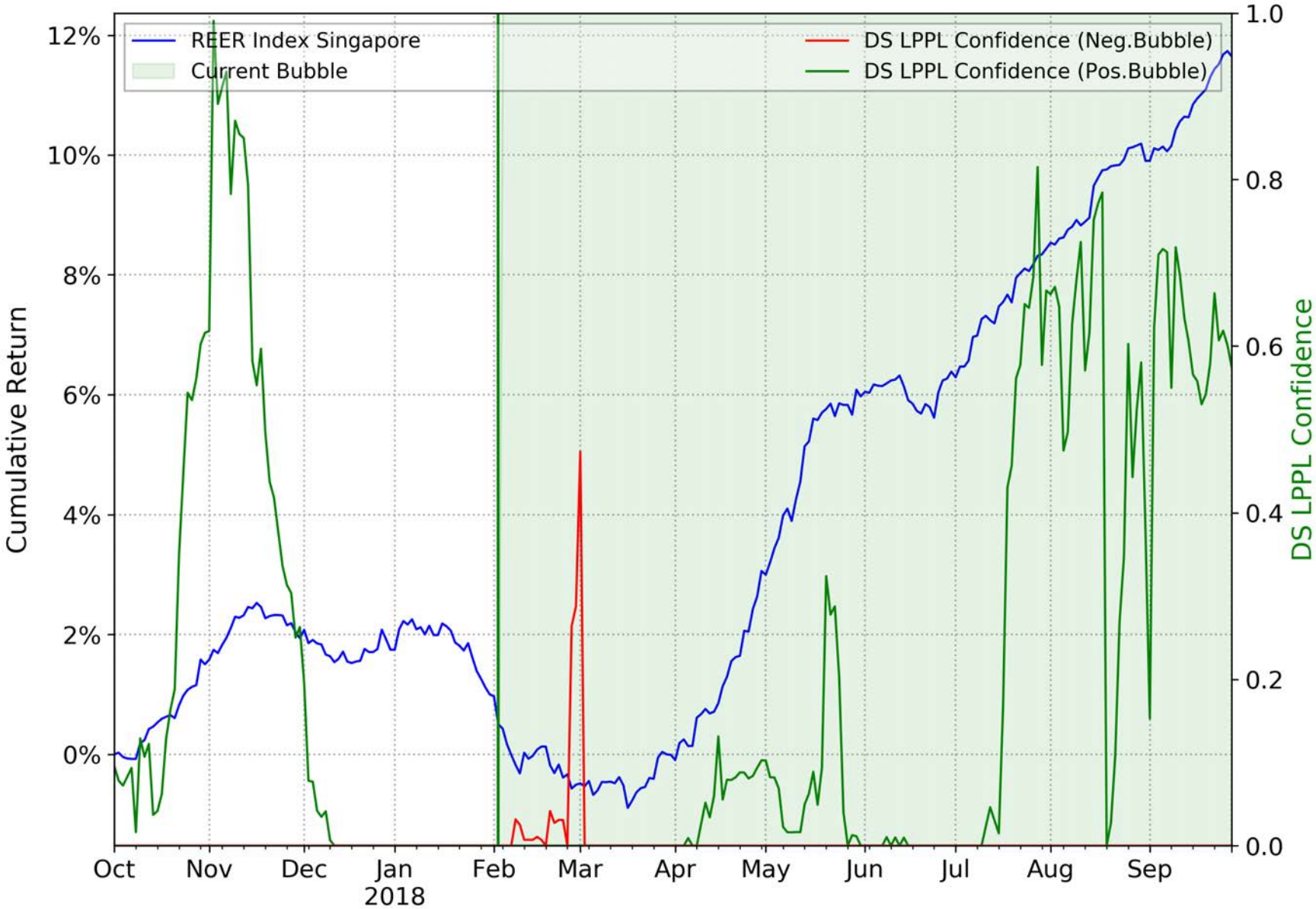
The REER Index analysis in the currency sector reveals a single asset to be in a positive bubble state, the REER Index Singapore. The reported bubble size amounts to 11% at a high level of the DS LPPL Confidence Indicator of 76%. A plot of this index is provided on the following slide.

Furthermore, we show the Principal Components resulting from the PCA performed on various currency pairs. None of the calculated PC's exhibit super-exponential dynamics.

Last month's reported Indicator values for the REER Index Egypt have declined, due to sideward plateauing of the price, as visible on an additional subsequent slide.

The cryptocurrency sector analysis, incorporating the top 1000 cryptocurrencies in terms of market capitalization on coinmarketcap.com, also does not reveal any bubble activity.

[1] Real Effective Exchange Rate (REER) is a measure of the trade-weighted average exchange rate of a currency against a basket of currencies after adjusting for inflation differentials with regard to the countries concerned and expressed as an index number relative to a base year. The larger the REER, the stronger the currency.


REER Index Singapore
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
12%
10%
8%
6%
4%
2%
0%
1.0
0.8
0.6
0.4
0.2
0.0
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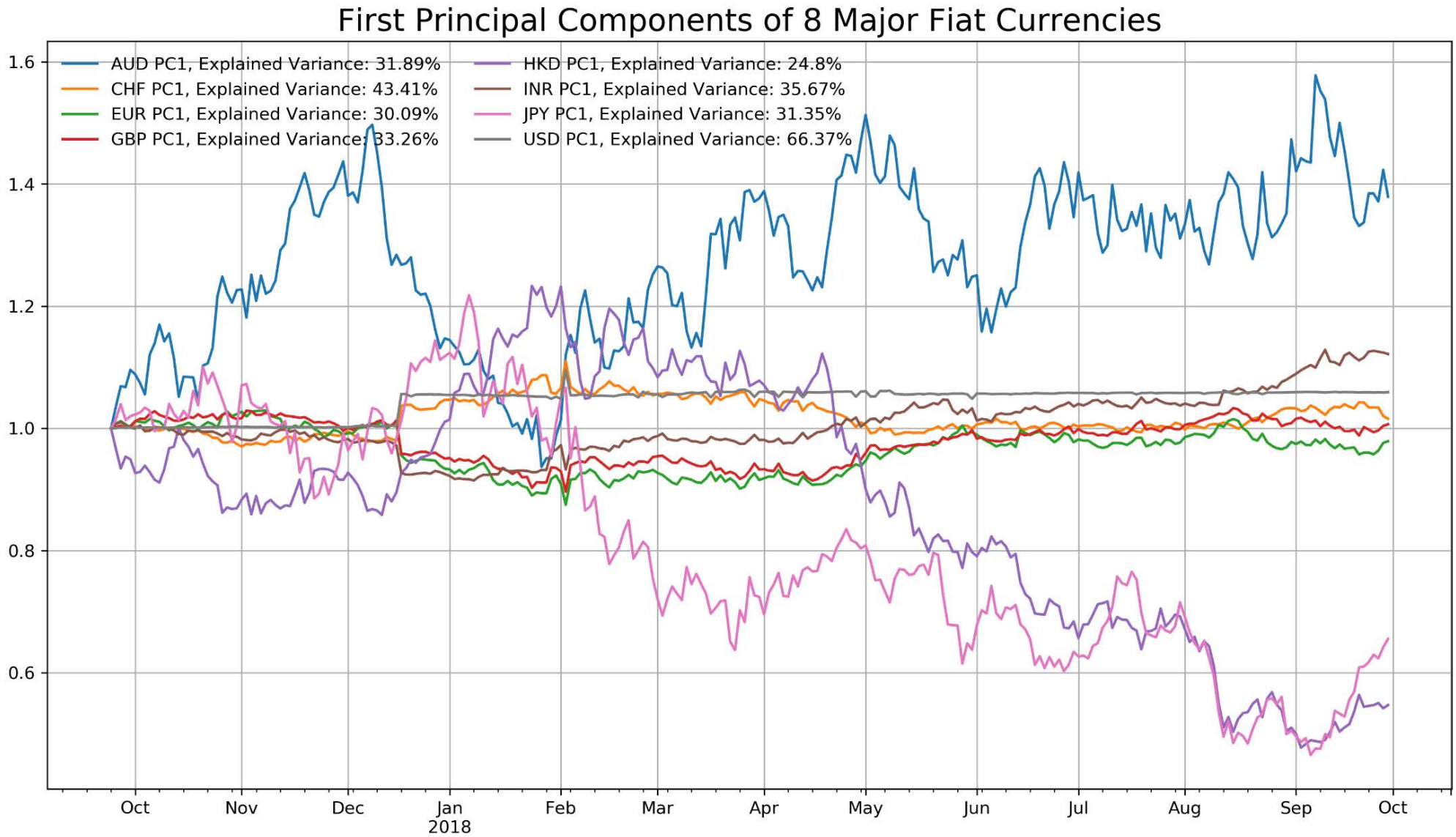
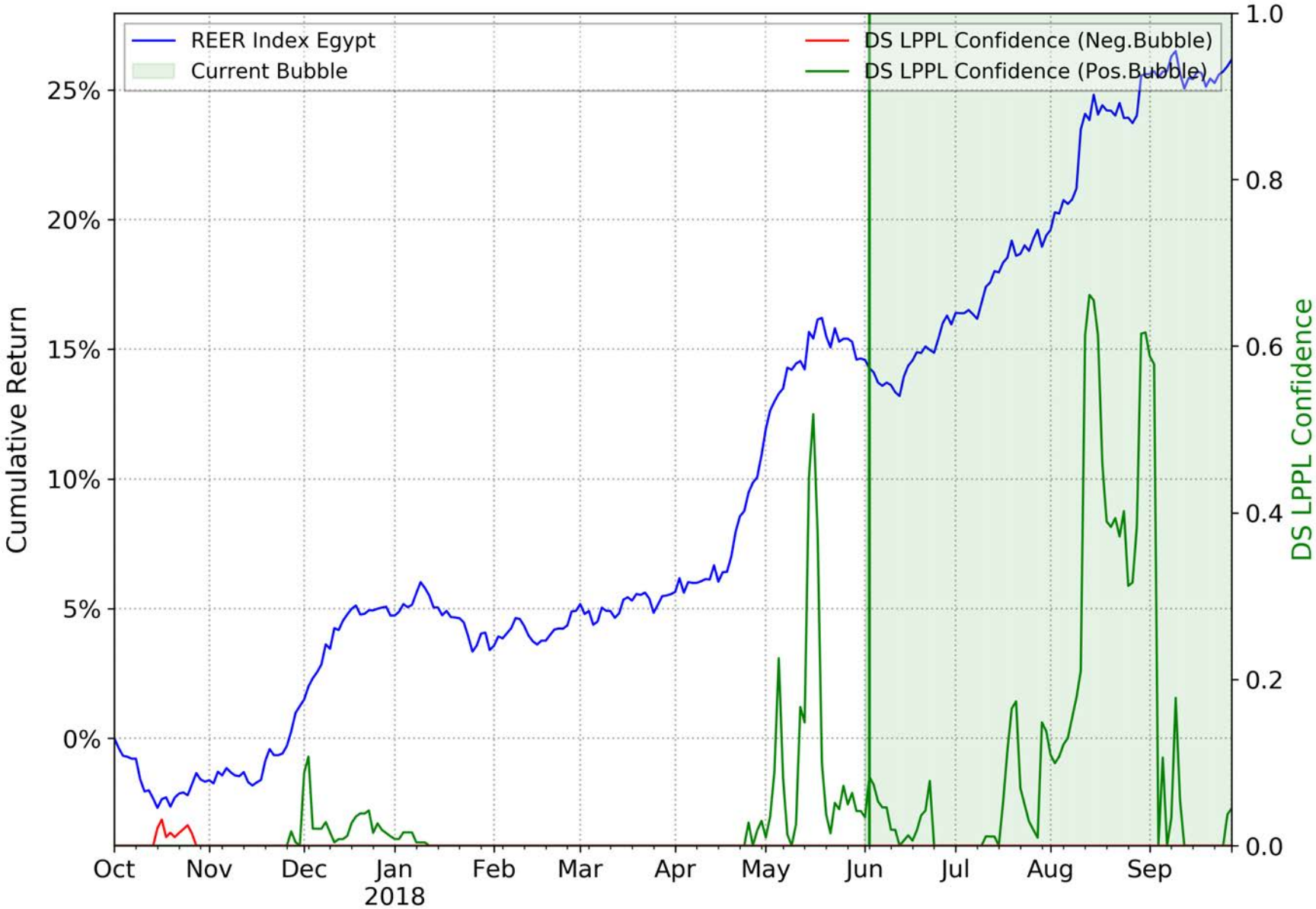
Currencies – PCA




REER Index Egypt
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
25%
20%
15%
10%
5%
0%
DS LPPL Confidence
1.0
0.8
0.6
0.4
0.2
0.0
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Single Stocks

For 768 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

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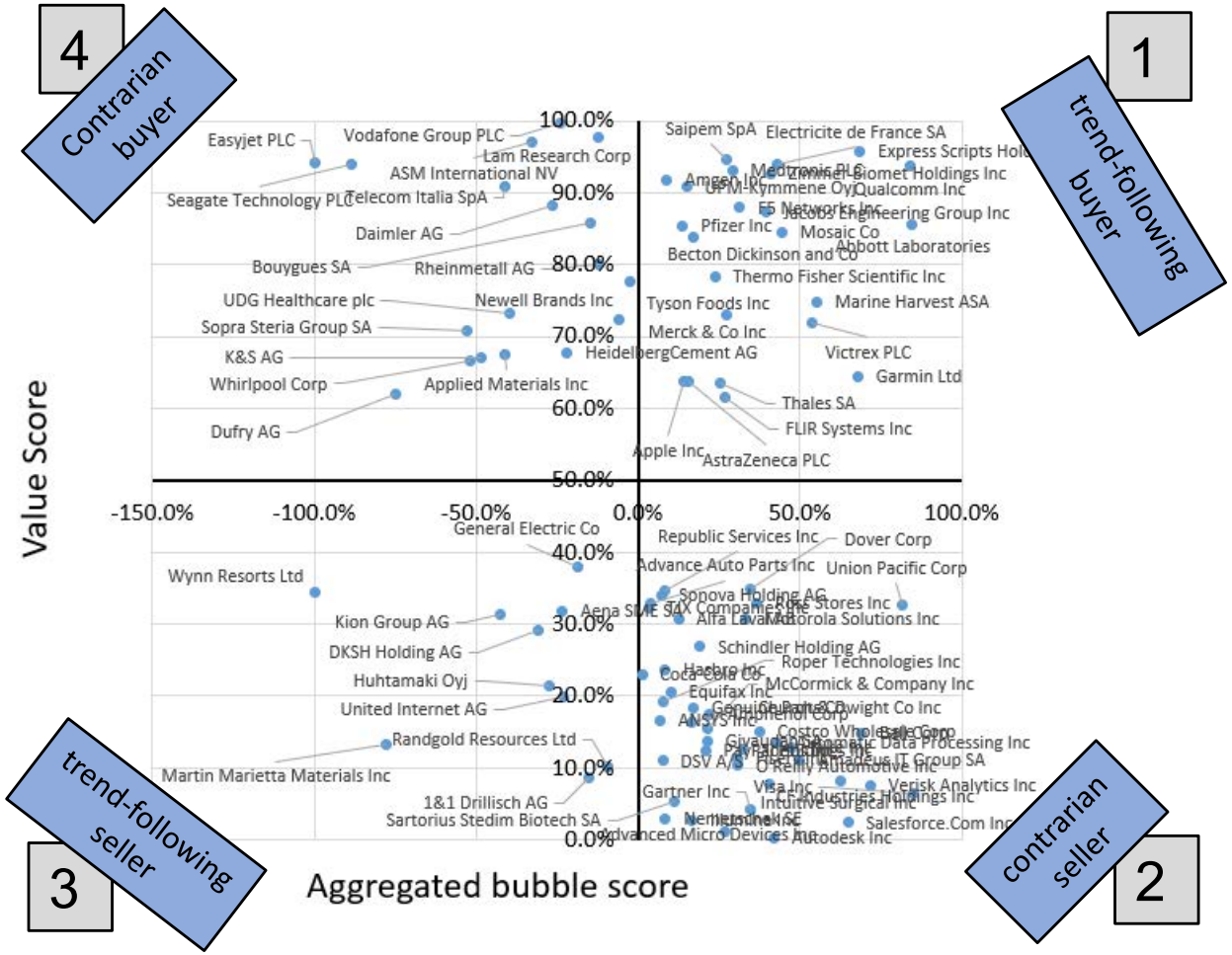
To analyze the financial strength of individual stocks, we have two indicators. Both scores give a value between zero and one, one being the best of the set and zero the worst, so the higher the score, the higher the financial strength.

- 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. Apple Inc);
2. Quadrant 2: Stocks with a strong positive bubble score and a weak value score (e.g. Gartner Inc);
3. Quadrant 3: Stocks with a strong negative bubble score and a weak value score (e.g. Wynn Resorts Ltd);
4. Quadrant 4: Stocks with strong negative bubble score and a strong financial strength (e.g. Dufry 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%.

Single Stocks

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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.

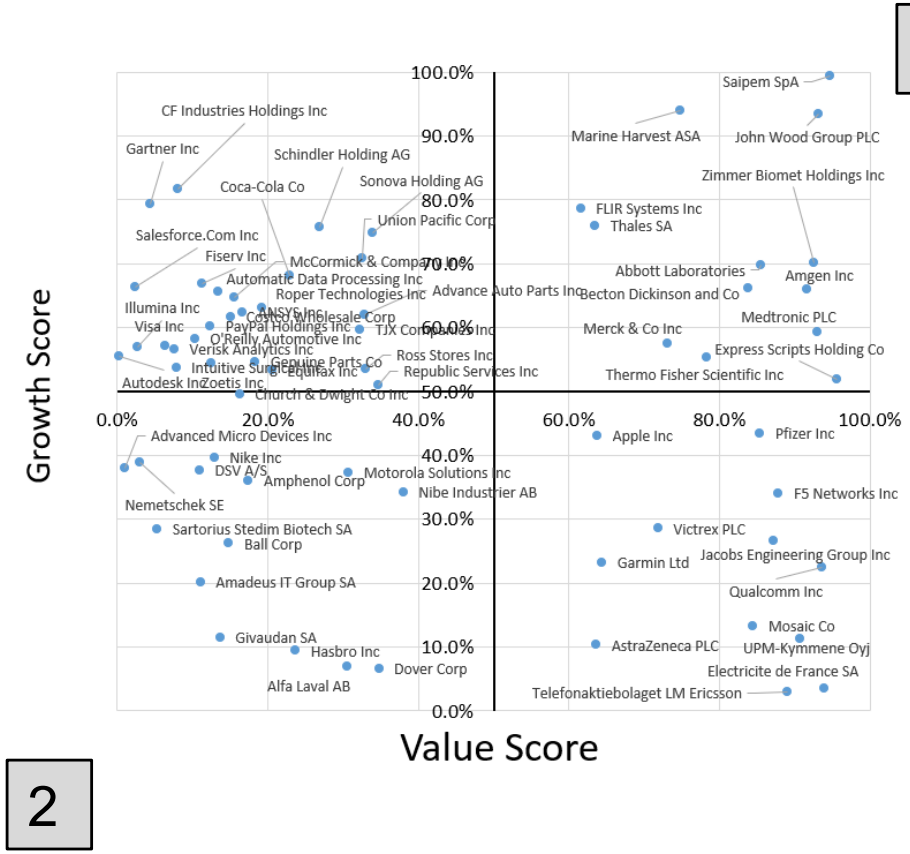
3. Quadrant 3: These stocks are expensive relative to their earnings potential. On top of that, there are clear negative bubble signals. Such stocks should be considered as falling knives. As an investor, one could be a trend-following seller.

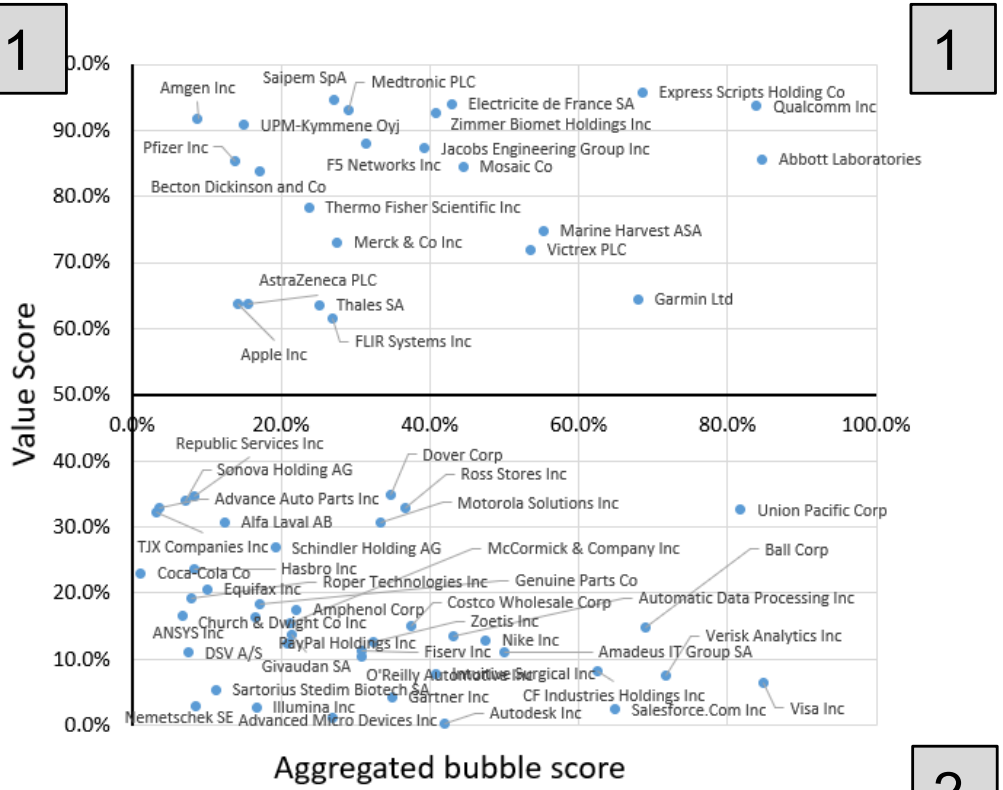
4. Quadrant 4: These stocks are cheap relative to their financial performance. The strong negative bubble signal is an indication of sentiment and herding. These stocks can be considered as over-sold. As an investor, one could be a contrarian buyer.

Single Stocks

Quadrant 1 and 2 stocks

Strong positive bubble signals with strong (respectively weak) fundamentals

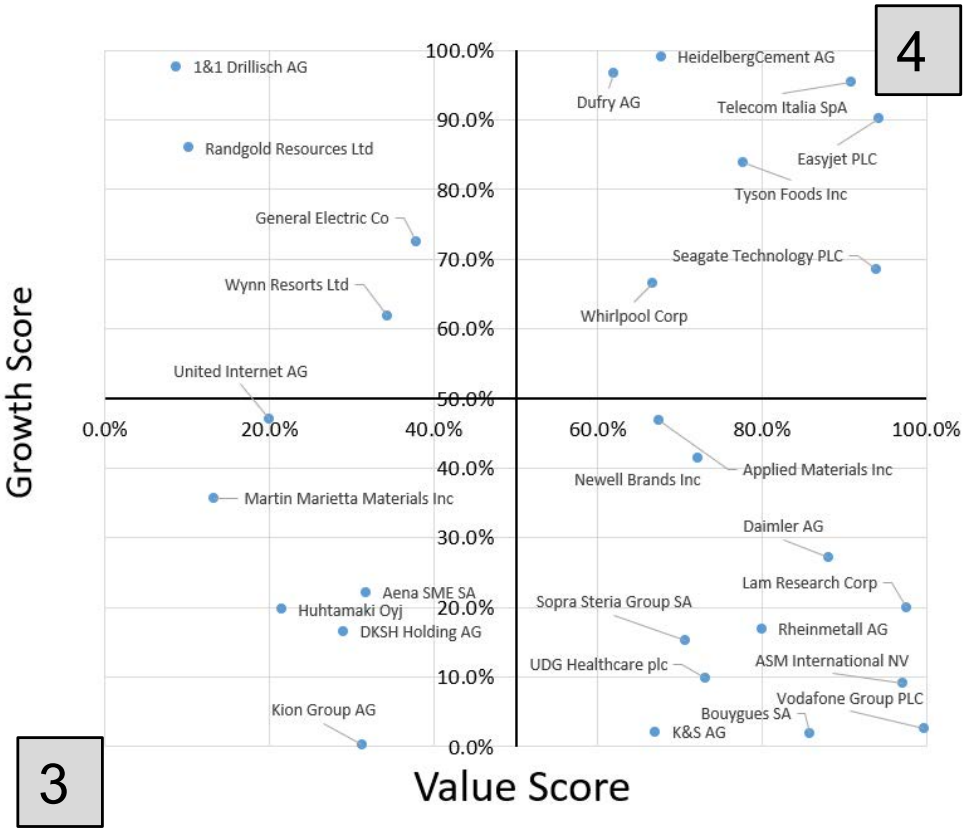


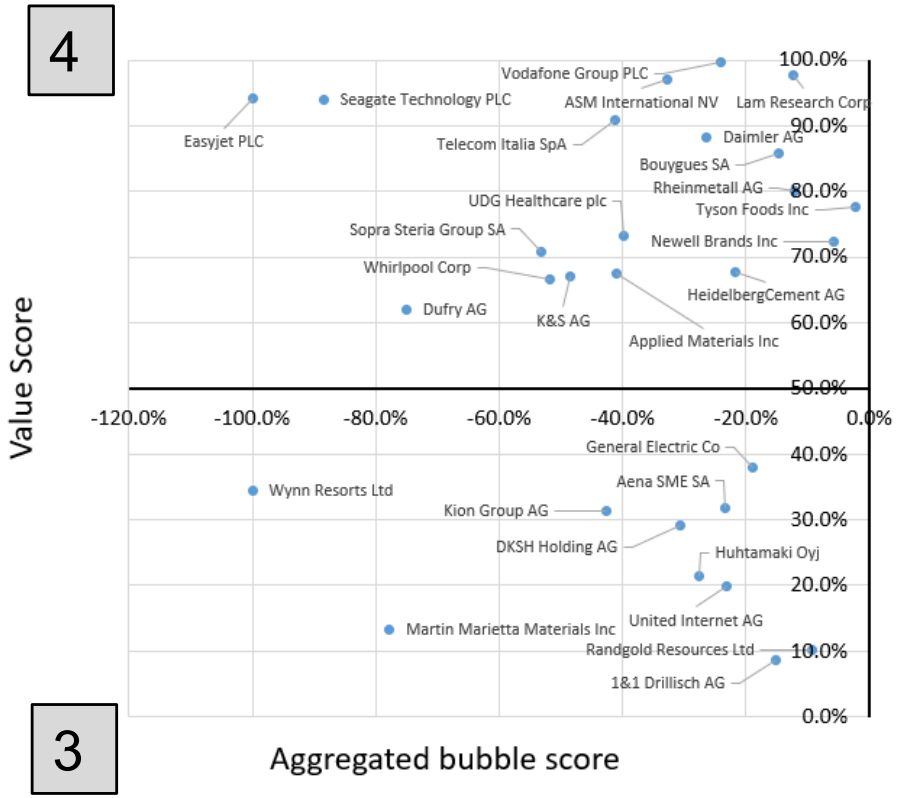


Single Stocks

Quadrant 3 and 4 stocks

Strong negative bubble signals with weak (respectively strong) fundamentals





Single Stocks

Entrepreneurial Risks
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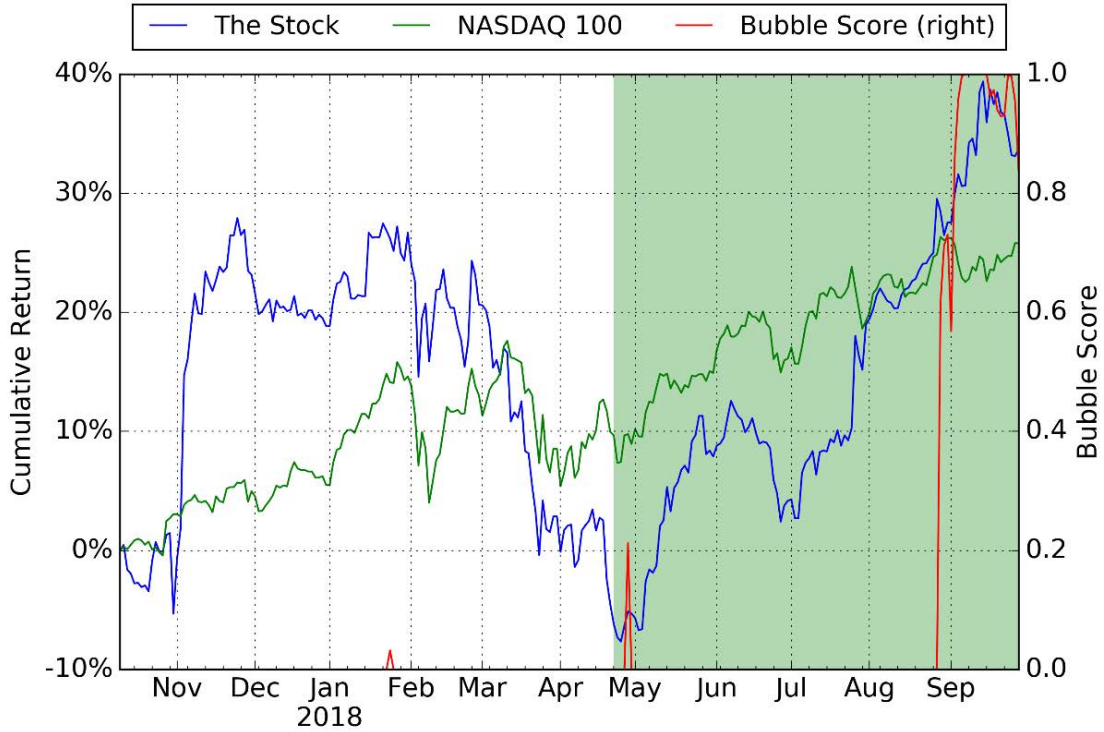
Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Apple Inc	United States of America	Technology Hardware & Equipment	44.7%	37.4%	Feb-18	14.2%	63.8%	43.1%
Amgen Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	13.4%	20.2%	Nov-17	8.8%	91.7%	66.0%
Express Scripts Holding Co	United States of America	Health Care Equipment & Services	64.7%	31.6%	May-18	68.5%	95.7%	52.0%
F5 Networks Inc	United States of America	Technology Hardware & Equipment	72.4%	44.9%	Jan-18	31.5%	87.9%	34.0%
FLIR Systems Inc	United States of America	Technology Hardware & Equipment	44.0%	42.6%	Oct-17	26.9%	61.6%	78.6%
Garmin Ltd	Switzerland	Consumer Durables & Apparel	28.1%	20.1%	Mar-18	67.9%	64.5%	23.2%
Qualcomm Inc	United States of America	Semiconductors & Semiconductor Equipment	35.9%	42.5%	Apr-18	83.9%	93.6%	22.5%
AstraZeneca PLC	United Kingdom	Pharmaceuticals, Biotechnology & Life Sciences	15.7%	18.1%	Jan-18	15.6%	63.7%	10.3%
Thales SA	France	Capital Goods	27.8%	11.9%	May-18	25.2%	63.5%	75.9%
Electricite de France SA	France	Utilities	36.6%	43.8%	Nov-17	42.9%	94.0%	3.5%
Saipem SpA	Italy	Energy	52.0%	55.2%	Feb-18	27.1%	94.7%	99.3%
UPM-Kymmene Oyj	Finland	Materials	40.0%	30.5%	Jan-18	15.0%	90.8%	11.2%
Marine Harvest ASA	Norway	Food, Beverage & Tobacco	15.7%	9.9%	Apr-18	55.2%	74.7%	93.9%
Abbott Laboratories	United States of America	Health Care Equipment & Services	34.1%	21.1%	May-18	84.7%	85.5%	69.8%
Becton Dickinson and Co	United States of America	Health Care Equipment & Services	31.3%	23.4%	Feb-18	17.2%	83.9%	66.1%
Jacobs Engineering Group Inc	United States of America	Capital Goods	30.7%	23.2%	May-18	39.3%	87.2%	26.7%
Medtronic PLC	Ireland; Republic of	Health Care Equipment & Services	26.2%	20.8%	Feb-18	29.1%	93.1%	59.4%
Mosaic Co	United States of America	Materials	53.0%	24.4%	May-18	44.4%	84.5%	13.3%
Merck & Co Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	11.1%	27.9%	Feb-18	27.5%	73.0%	57.4%
Pfizer Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	21.2%	23.8%	Mar-18	13.8%	85.4%	43.5%
Thermo Fisher Scientific Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	26.2%	17.7%	Mar-18	23.7%	78.4%	55.3%
Zimmer Biomet Holdings Inc	United States of America	Health Care Equipment & Services	9.0%	23.6%	Apr-18	40.8%	92.6%	70.1%
Victrex PLC	United Kingdom	Materials	36.3%	25.4%	Apr-18	53.5%	71.9%	28.5%
Telefonaktiebolaget LM Ericsson	Sweden	Technology Hardware & Equipment	68.3%	55.6%	Nov-17	24.8%	89.1%	3.0%
John Wood Group PLC	United Kingdom	Energy	6.9%	42.8%	Mar-18	40.7%	93.2%	93.4%

Single Stocks - Quadrant 1 stocks

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Example: Qualcomm Inc.

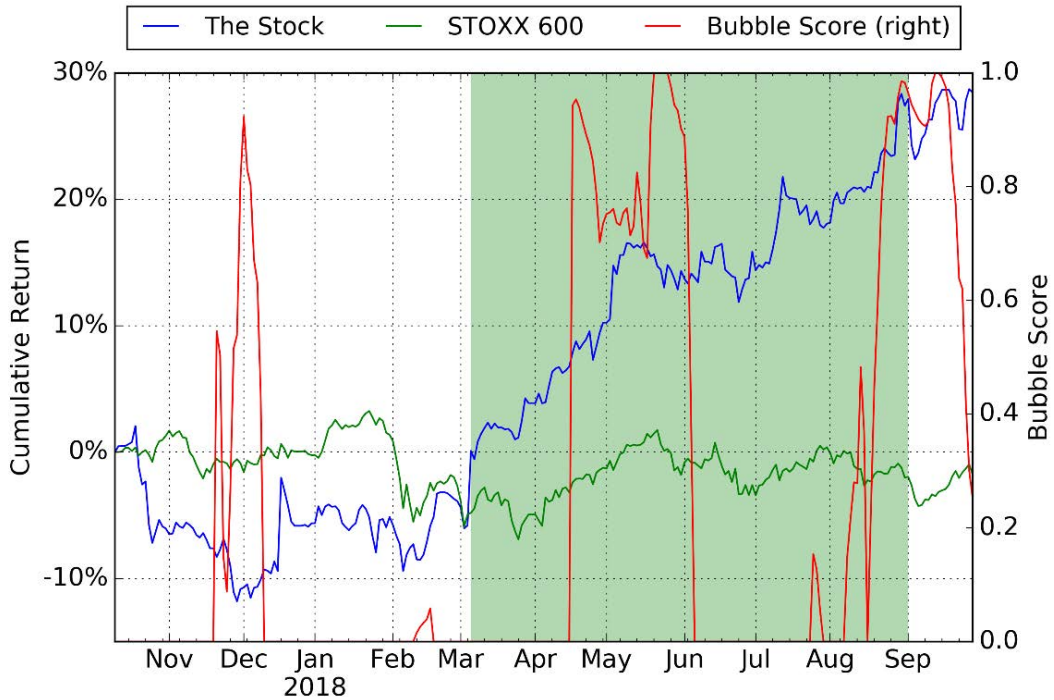


The above graph shows the one year cumulative return of the stock in blue (left hand scale), NASDAQ 100 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this five month bubble has reached 83.9% with a bubble size 42.5%. A correction has started recently, which may indicate a regime shift.

Single Stocks - Quadrant 1 stocks

Last month example: strong positive bubble signals with strong fundamentals, Thales SA.

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 continued to strengthen with some volatility, which is in agreement with the DS LPPLS indicator and the strong fundamentals.



Single Stocks - Quadrant 2 stocks

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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
Automatic Data Processing Inc	United States of America	Software & Services	32.6%	35.6%	Nov-17	43.1%	13.4%	65.6%
Autodesk Inc	United States of America	Software & Services	31.2%	42.8%	Nov-17	41.9%	0.3%	55.5%
Advanced Micro Devices Inc	United States of America	Semiconductors & Semiconductor Equipment	117.5%	165.2%	Feb-18	26.9%	1.0%	38.0%
ANSYS Inc	United States of America	Software & Services	44.4%	14.9%	Feb-18	6.8%	16.7%	62.4%
Costco Wholesale Corp	United States of America	Food & Staples Retailing	49.4%	26.5%	Mar-18	37.5%	15.1%	61.6%
Fiserv Inc	United States of America	Software & Services	29.6%	17.7%	Mar-18	30.8%	11.3%	66.8%
Hasbro Inc	United States of America	Consumer Durables & Apparel	8.8%	12.2%	Nov-17	8.4%	23.7%	9.4%
Illumina Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	76.3%	52.2%	Mar-18	16.7%	2.7%	57.0%
Intuitive Surgical Inc	United States of America	Health Care Equipment & Services	58.3%	43.7%	Feb-18	40.7%	7.8%	53.8%
O'Reilly Automotive Inc	United States of America	Retailing	67.8%	37.5%	Feb-18	30.8%	10.3%	58.2%
PayPal Holdings Inc	United States of America	Software & Services	27.6%	27.6%	Oct-17	20.8%	12.4%	60.2%
Ross Stores Inc	United States of America	Retailing	56.6%	25.3%	Feb-18	36.7%	32.9%	53.5%
Verisk Analytics Inc	United States of America	Commercial & Professional Services	43.8%	18.1%	Mar-18	71.7%	7.6%	56.6%
Nemetschek SE	Germany	Software & Services	64.1%	63.5%	Jan-18	8.5%	3.0%	38.8%
DSV A/S	Denmark	Transportation	24.5%	19.0%	Jan-18	7.5%	10.9%	37.6%
Amadeus IT Group SA	Spain	Software & Services	39.3%	31.2%	Apr-18	50.0%	11.1%	20.1%
Sartorius Stedim Biotech SA	France	Pharmaceuticals, Biotechnology & Life Sciences	100.4%	70.5%	Feb-18	11.3%	5.3%	28.4%
Givaudan SA	Switzerland	Materials	11.3%	12.5%	Mar-18	21.4%	13.7%	11.5%
Schindler Holding AG	Switzerland	Capital Goods	11.4%	20.8%	Mar-18	19.2%	26.8%	75.8%
Sonova Holding AG	Switzerland	Health Care Equipment & Services	12.3%	26.6%	Nov-17	7.1%	34.0%	74.7%
Advance Auto Parts Inc	United States of America	Retailing	94.5%	44.3%	Mar-18	3.7%	32.8%	62.0%

Single Stocks - Quadrant 2 stocks

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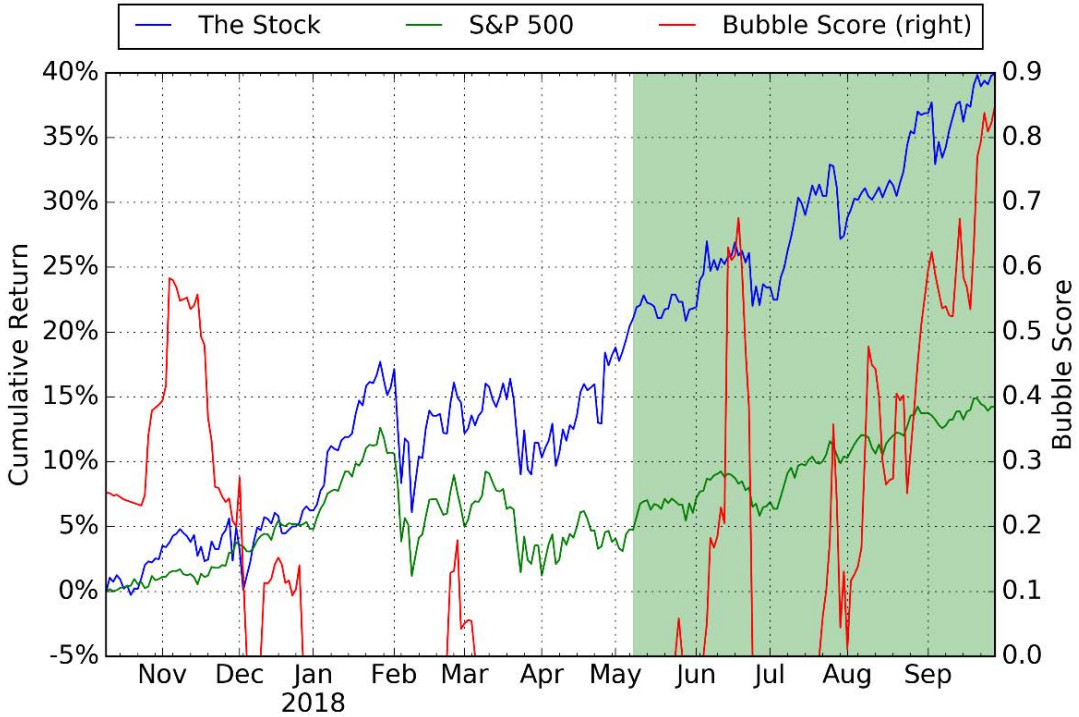
Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Amphenol Corp	United States of America	Technology Hardware & Equipment	7.1%	10.2%	Mar-18	22.1%	17.4%	35.9%
Ball Corp	United States of America	Materials	4.1%	14.3%	May-18	69.0%	14.8%	26.2%
CF Industries Holdings Inc	United States of America	Materials	51.9%	39.6%	Mar-18	62.5%	8.1%	81.8%
Church & Dwight Co Inc	United States of America	Household & Personal Products	24.4%	26.9%	Nov-17	16.5%	16.3%	49.5%
Salesforce.Com Inc	United States of America	Software & Services	64.4%	23.5%	May-18	64.9%	2.3%	66.4%
Dover Corp	United States of America	Capital Goods	16.6%	22.2%	May-18	34.7%	34.8%	6.5%
Equifax Inc	United States of America	Commercial & Professional Services	20.0%	14.5%	Feb-18	10.1%	20.6%	53.3%
Genuine Parts Co	United States of America	Retailing	3.7%	7.4%	Feb-18	17.2%	18.4%	54.6%
Gartner Inc	United States of America	Software & Services	28.3%	31.7%	Nov-17	34.9%	4.3%	79.4%
Coca-Cola Co	United States of America	Food, Beverage & Tobacco	0.2%	2.9%	Feb-18	1.2%	22.9%	68.2%
McCormick & Company Inc	United States of America	Food, Beverage & Tobacco	33.1%	26.9%	Apr-18	21.3%	15.5%	64.7%
Motorola Solutions Inc	United States of America	Technology Hardware & Equipment	44.9%	23.9%	Feb-18	33.4%	30.7%	37.2%
Nike Inc	United States of America	Consumer Durables & Apparel	66.7%	33.9%	Dec-17	47.5%	12.9%	39.6%
Roper Technologies Inc	United States of America	Capital Goods	17.5%	11.4%	Apr-18	8.0%	19.3%	63.2%
Republic Services Inc	United States of America	Commercial & Professional Services	14.1%	9.1%	Mar-18	8.3%	34.6%	50.9%
TJX Companies Inc	United States of America	Retailing	56.1%	35.5%	Feb-18	3.2%	32.3%	59.6%
Union Pacific Corp	United States of America	Transportation	43.2%	18.8%	May-18	81.8%	32.6%	70.8%
Visa Inc	United States of America	Software & Services	38.8%	15.5%	May-18	84.9%	6.4%	57.2%
Zoetis Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	41.1%	16.6%	Feb-18	32.3%	12.5%	54.4%
Alfa Laval AB	Sweden	Capital Goods	19.7%	24.4%	Dec-17	12.4%	30.6%	6.9%
Nibe Industrier AB	Sweden	Capital Goods	31.7%	38.3%	Mar-18	36.5%	38.0%	34.2%

Single Stocks - Quadrant 2 stocks

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Example: Visa Inc.

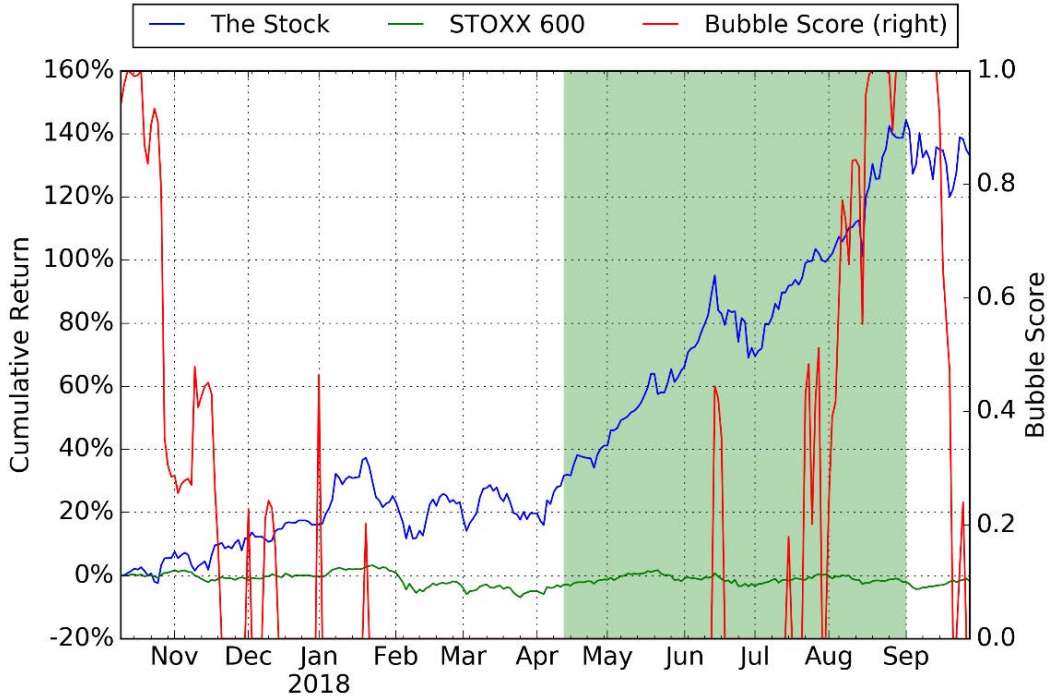


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this five month bubble has reached 84.9% with a bubble size 15.5%. 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, Wirecard 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 in last month. Note that the stock price stopped its appreciation and went into a volatile plateau in the recent month, which in agreement with the weak fundamentals and our DS LPPLS indicator.



Single Stocks - Quadrant 3 stocks

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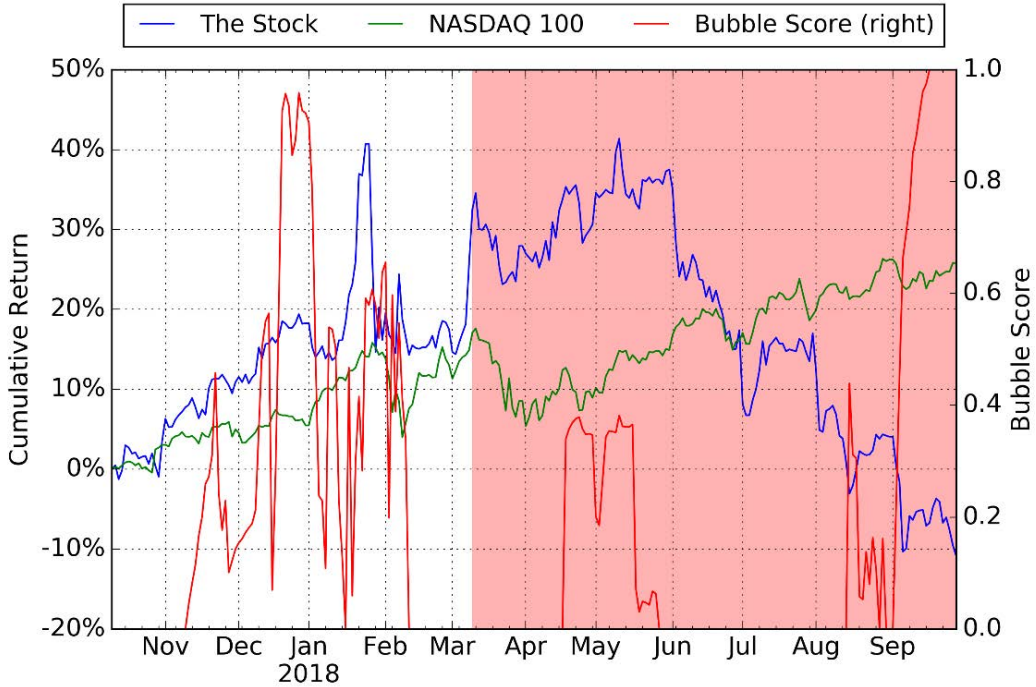
Quadrant 3 stocks: strong negative bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Wynn Resorts Ltd	United States of America	Consumer Services	-9.7%	-32.7%	Mar-18	-100.0%	34.4%	61.8%
1&1 Drillisch AG	Germany	Telecommunication Services	-31.4%	-28.0%	Apr-18	-15.2%	8.7%	97.7%
Kion Group AG	Germany	Capital Goods	-31.0%	-27.2%	Dec-17	-42.5%	31.4%	0.3%
United Internet AG	Germany	Telecommunication Services	-24.8%	-20.9%	Mar-18	-23.2%	19.9%	47.0%
Aena SME SA	Spain	Transportation	-1.5%	-14.8%	Jan-18	-23.3%	31.8%	22.1%
Huhtamaki Oyj	Finland	Materials	-24.4%	-20.8%	Feb-18	-27.7%	21.5%	19.7%
Randgold Resources Ltd	Jersey	Materials	-27.5%	-16.5%	Feb-18	-9.2%	10.2%	85.9%
DKSH Holding AG	Switzerland	Commercial & Professional Services	-21.6%	-26.6%	Jan-18	-30.7%	29.0%	16.5%
General Electric Co	United States of America	Capital Goods	-51.0%	-18.1%	Apr-18	-18.8%	37.9%	72.4%
Martin Marietta Materials Inc	United States of America	Materials	-11.7%	-14.8%	May-18	-77.8%	13.3%	35.7%

Single Stocks - Quadrant 3 stocks

Quadrant 3 stocks: strong negative bubble signals with weak fundamentals
Example: Wynn Resorts Ltd.

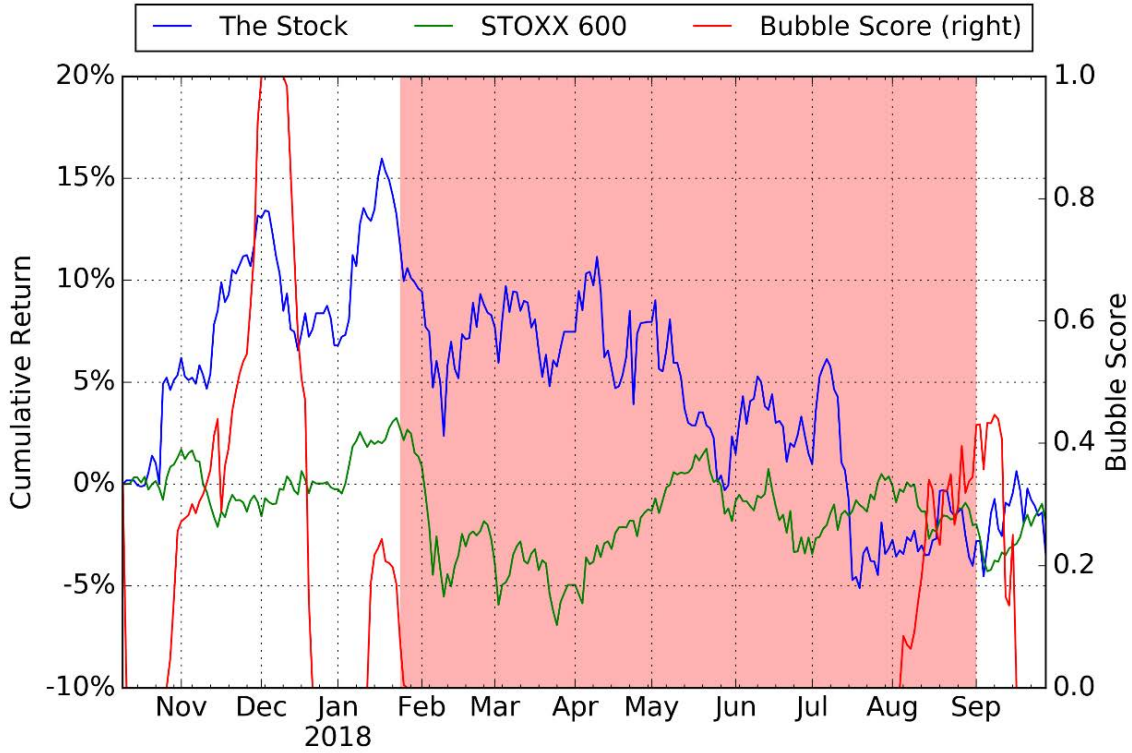


The above graph shows the one year cumulative return of the stock in blue (left hand scale), NASDAQ 100 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the negative bubble we identified. The Bubble Score of this seven month bubble has reached 100% with a bubble size -32.7%.

Single Stocks - Quadrant 3 stocks

Last month example: strong negative bubble signals with weak fundamentals, Telenor ASA.

The figure below plots the one year cumulative return of the stock (blue), STOXX 600 (green) and LPPLS Bubble Score (red line on the right y-axis). The red shaded period is the strong negative bubble we identified and reported in last month. The stock continued its plateau in the recent month, which is in agreement with the weak fundamentals and our DS LPPLS indicator.



Single Stocks - Quadrant 4 stocks

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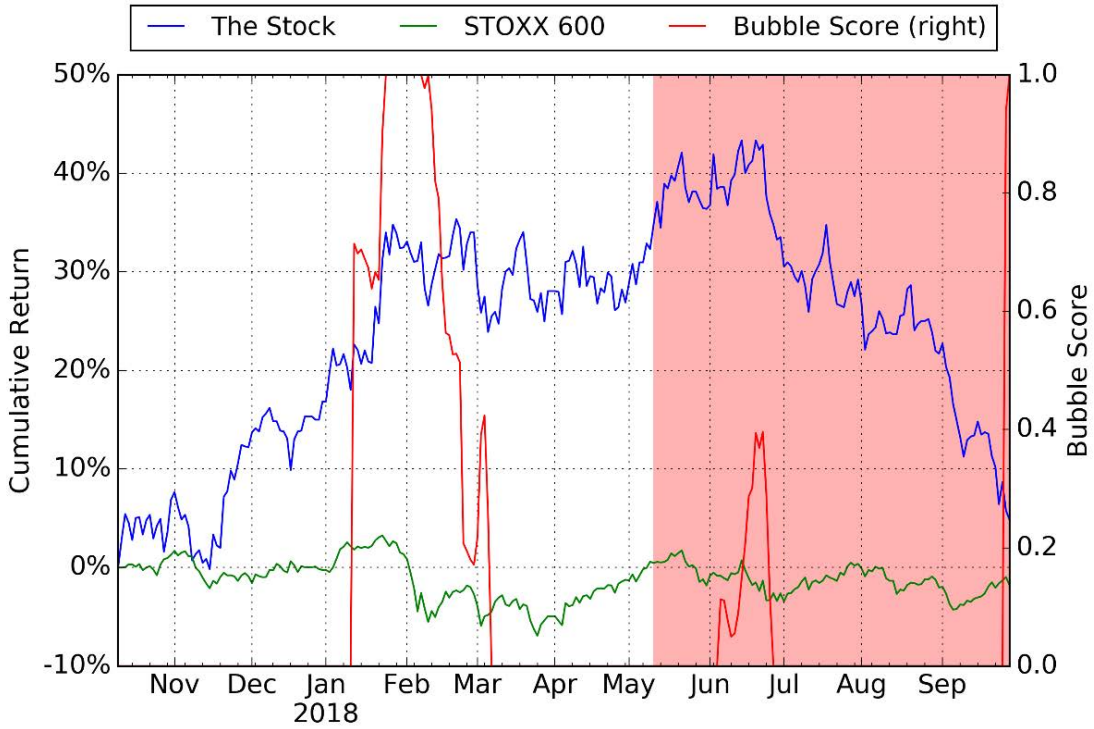
Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Applied Materials Inc	United States of America	Semiconductors & Semiconductor Equipment	-27.5%	-27.5%	Oct-17	-41.0%	67.4%	46.7%
Lam Research Corp	United States of America	Semiconductors & Semiconductor Equipment	-18.9%	-28.4%	Mar-18	-12.4%	97.7%	19.9%
Seagate Technology PLC	Ireland; Republic of	Technology Hardware & Equipment	40.8%	-17.3%	May-18	-88.4%	93.9%	68.5%
Vodafone Group PLC	United Kingdom	Telecommunication Services	-25.3%	-28.8%	Nov-17	-24.1%	99.7%	2.6%
Daimler AG	Germany	Automobiles & Components	-20.1%	-23.6%	Oct-17	-26.4%	88.2%	27.2%
HeidelbergCement AG	Germany	Materials	-21.6%	-25.5%	Nov-17	-21.8%	67.7%	99.0%
Rheinmetall AG	Germany	Capital Goods	-7.8%	-18.7%	Mar-18	-12.0%	79.9%	16.9%
K&S AG	Germany	Materials	-12.4%	-19.2%	Feb-18	-48.5%	67.1%	2.1%
Easyjet PLC	United Kingdom	Transportation	-0.5%	-22.2%	May-18	-100.0%	94.3%	90.2%
Bouygues SA	France	Capital Goods	-6.7%	-13.5%	Nov-17	-14.6%	85.8%	2.0%
Sopra Steria Group SA	France	Software & Services	-13.1%	-21.3%	Apr-18	-53.1%	70.7%	15.2%
ASM International NV	Netherlands	Semiconductors & Semiconductor Equipment	-18.3%	-28.1%	Nov-17	-32.7%	97.1%	9.1%
Telecom Italia SpA	Italy	Telecommunication Services	-31.0%	-30.0%	Dec-17	-41.2%	90.9%	95.4%
Dufry AG	Switzerland	Retailing	-29.4%	-19.1%	Apr-18	-75.0%	62.0%	96.7%
Newell Brands Inc	United States of America	Consumer Durables & Apparel	-52.5%	-32.4%	Nov-17	-5.8%	72.3%	41.4%
Tyson Foods Inc	United States of America	Food, Beverage & Tobacco	-15.9%	-21.8%	Jan-18	-2.3%	77.7%	83.9%
Whirlpool Corp	United States of America	Consumer Durables & Apparel	-32.9%	-28.2%	Nov-17	-51.8%	66.7%	66.5%
UDG Healthcare plc	Ireland; Republic of	Health Care Equipment & Services	-24.3%	-25.1%	Apr-18	-39.8%	73.2%	9.9%

Single Stocks - Quadrant 4 stocks

Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

Example: Easyjet PLC.

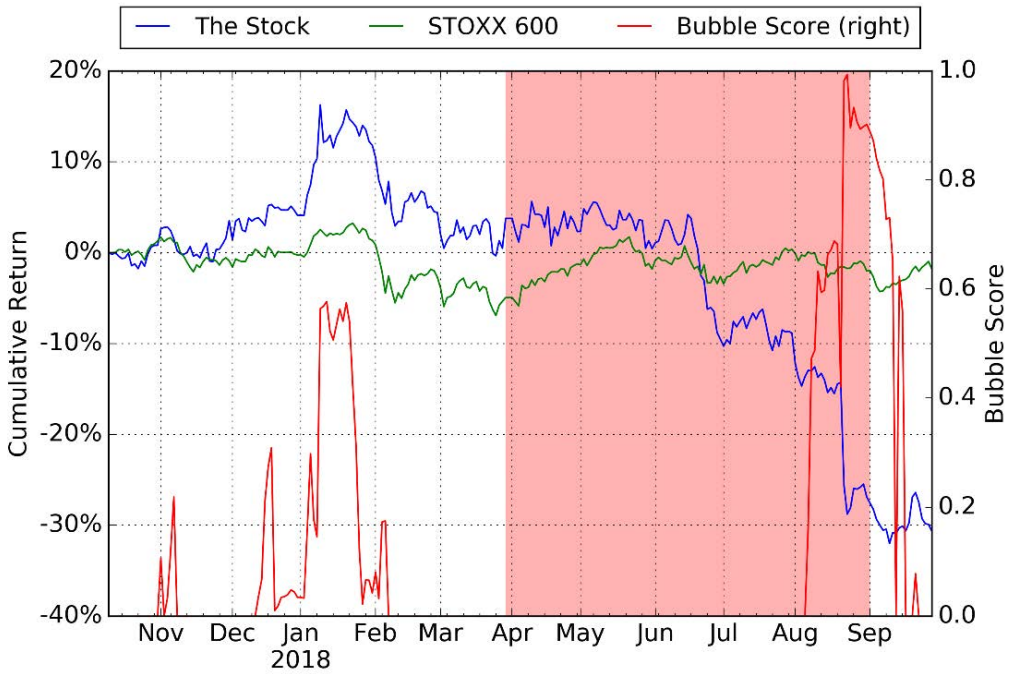


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this five month bubble has reached 100% with a bubble size -22.2%. 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, Continental AG.

The figure below plots the one year cumulative return of the stock (blue), STOXX 600 (green) and LPPLS Bubble Score (red line on the right y-axis). The red shaded period is the strong negative bubble we identified and reported in last month. The stock has stopped its drawdown in the past month, which is in agreement with our DS LPPLS indicator and strong fundamentals. We expect this stock to appreciate further in the future due to the strong fundamentals and following its neglect by investors in previous months.



Sectors

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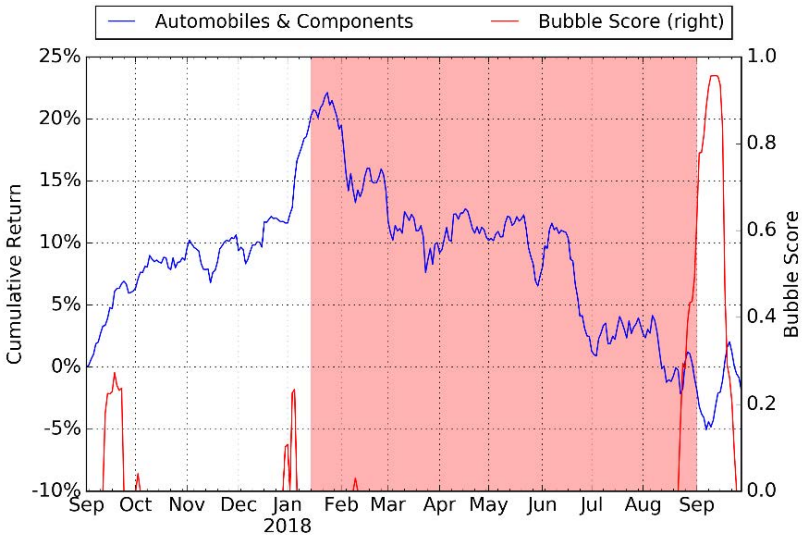
GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	Oct 1st	Sep 1st	Oct 1st	Sep 1st	Oct 1st	Sep 1st	Oct 1st	Sep 1st	Oct 1st	Sep 1st
Pharmaceuticals, Biotechnology & Life Sciences	4.3%	3.6%	0.0%	0.0%	0.0%	0.0%	64.7%	64.2%	56.8%	57.2%
Consumer Services	3.8%	5.9%	0.0%	0.0%	0.0%	0.0%	30.0%	28.1%	46.8%	47.2%
Retailing	47.5%	48.3%	0.0%	0.0%	0.0%	0.0%	18.8%	17.1%	57.5%	57.9%
Transportation	9.4%	10.7%	0.0%	0.0%	0.0%	0.0%	58.6%	60.2%	55.9%	56.3%
Consumer Durables & Apparel	12.9%	14.9%	0.0%	0.0%	0.0%	0.0%	37.4%	35.2%	54.8%	54.8%
Semiconductors & Semiconductor Equipment	10.2%	22.0%	0.0%	0.0%	0.0%	0.0%	57.6%	62.6%	29.1%	29.9%
Technology Hardware & Equipment	30.1%	32.0%	19.6%	0.0%	18.5%	0.0%	69.5%	67.7%	42.4%	43.2%
Automobiles & Components	-9.5%	-4.6%	0.0%	-17.6%	0.0%	-49.2%	77.1%	76.8%	49.2%	50.3%
Telecommunication Services	-3.8%	-4.5%	0.0%	0.0%	0.0%	0.0%	60.6%	57.5%	38.4%	38.3%
Energy	11.8%	12.4%	0.0%	0.0%	0.0%	0.0%	50.4%	51.4%	51.9%	52.4%
Software & Services	25.6%	28.7%	0.0%	0.0%	0.0%	0.0%	43.1%	37.0%	45.0%	48.0%
Materials	0.2%	1.7%	0.0%	0.0%	0.0%	0.0%	52.5%	52.7%	43.3%	44.0%
Health Care Equipment & Services	26.8%	22.0%	15.7%	13.2%	100.0%	36.5%	67.0%	65.1%	58.2%	58.5%
Capital Goods	2.4%	3.8%	0.0%	0.0%	0.0%	0.0%	47.4%	47.5%	52.9%	53.1%
Media	6.6%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	41.9%	0.0%	51.4%
Commercial & Professional Services	9.6%	14.2%	0.0%	10.1%	0.0%	81.0%	32.9%	28.4%	48.7%	51.6%
Food & Staples Retailing	14.5%	11.8%	7.5%	7.2%	30.2%	96.0%	60.4%	59.0%	59.9%	59.3%
Household & Personal Products	-1.0%	-1.2%	0.0%	0.0%	0.0%	0.0%	34.5%	34.1%	50.3%	51.4%
Food, Beverage & Tobacco	-7.4%	-6.7%	0.0%	0.0%	0.0%	0.0%	44.5%	43.0%	58.1%	58.5%
Utilities	-4.0%	-3.8%	0.0%	0.0%	0.0%	0.0%	52.5%	52.5%	44.8%	45.7%
Insurance	0.6%	1.8%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Real Estate	-2.2%	0.6%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Diversified Financials	2.4%	9.5%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Banks	-3.8%	0.8%	0.0%	0.0%	0.0%	0.0%	-	-	-	-

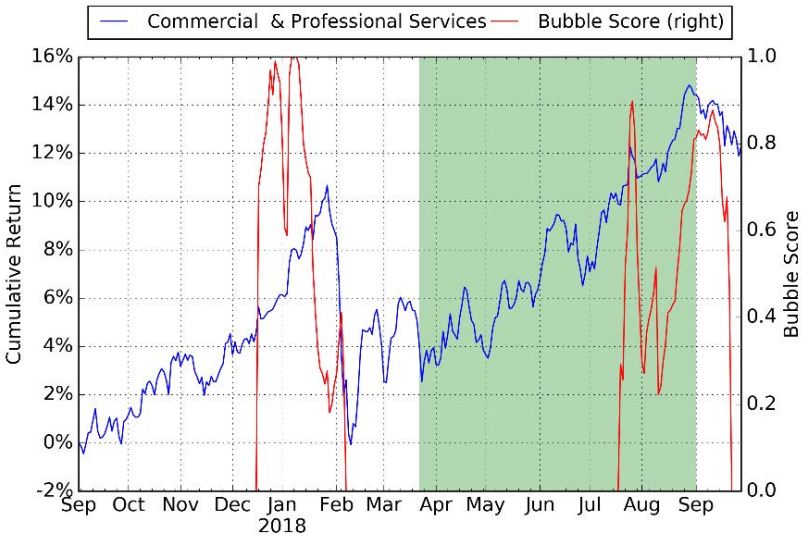
Sectors

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.

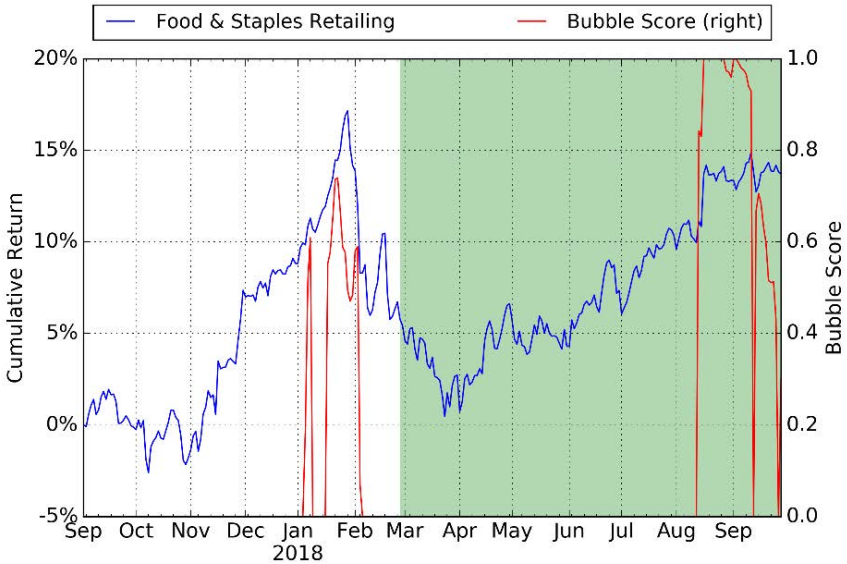
This month, we find 3 industry groups with a positive bubble score: *Food & Staples Retailing*, *Health Care Equipment & Services*, and *Technology Hardware & Equipment* as shown in the figures in the next slide. *Health Care Equipment & Services,* and *Food & Staples Retailing* are the two industry groups that we reported last month. The price index of *Health Care Equipment & Services* continued to appreciate, which leads to a bubble score of 100%, while Food & Staples Retailing has went into a plateau with a lower bubble score.

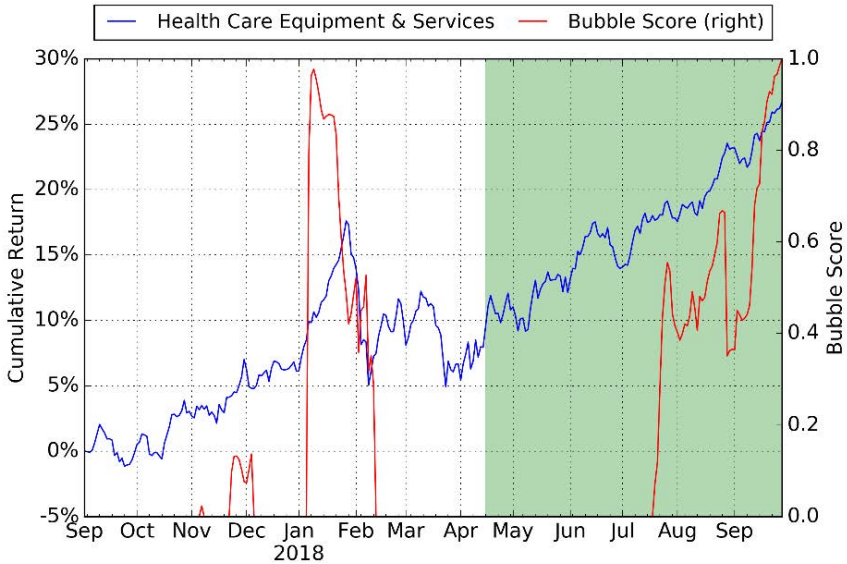
Below shows the performance of the other two industry groups we reported last month. Both of them have stopped their previous trend and seem to go into another market regime.

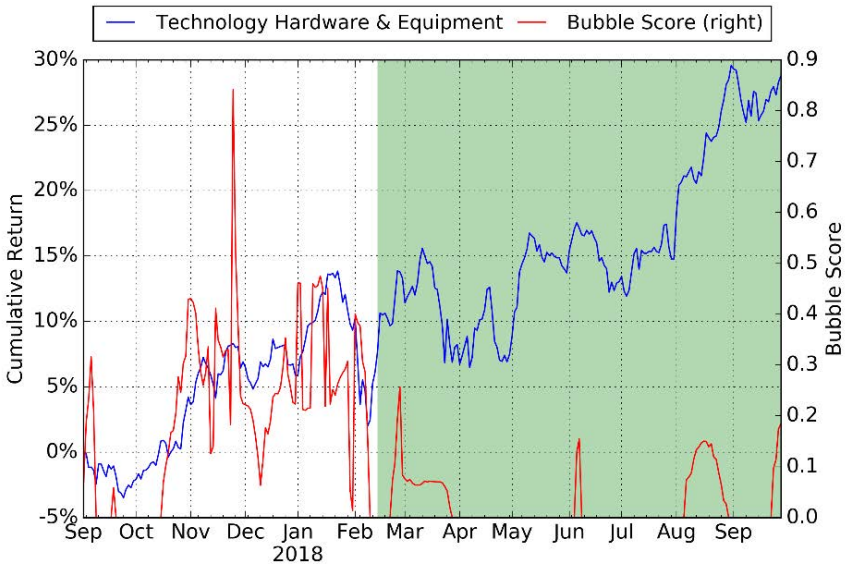




Sectors


Food & Staples Retailing
Bubble Score (right)
Cumulative Return
Bubble Score
20%
15%
10%
5%
0%
-5%
1.0
0.8
0.6
0.4
0.2
0.0
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
2018


Health Care Equipment & Services
Bubble Score (right)
Cumulative Return
Bubble Score
30%
25%
20%
15%
10%
5%
0%
-5%
1.0
0.8
0.6
0.4
0.2
0.0
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
2018


Technology Hardware & Equipment
Bubble Score (right)
Cumulative Return
Bubble Score
30%
25%
20%
15%
10%
5%
0%
-5%
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
2018

Portfolio Construction & Performance

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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

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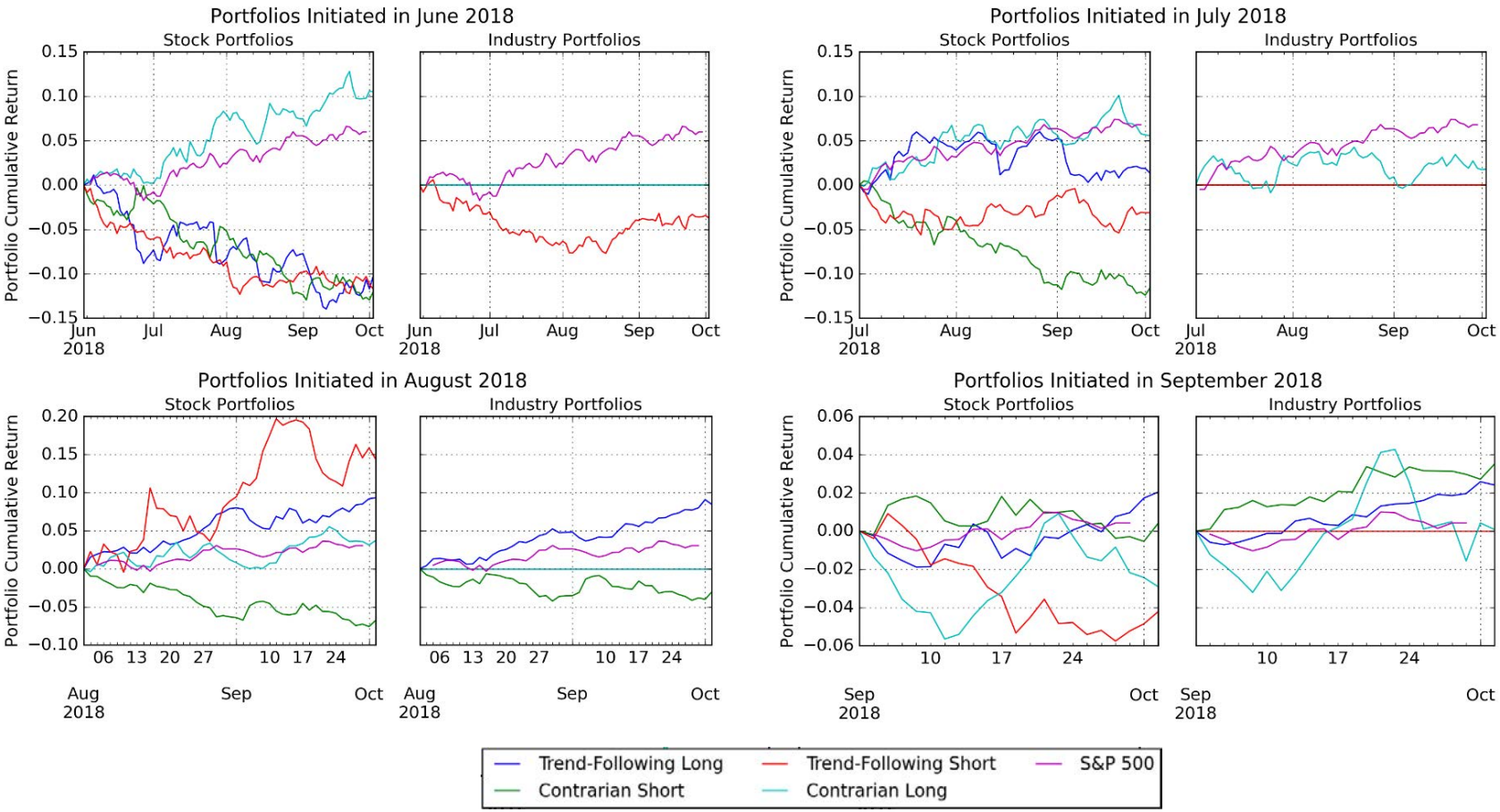
At the same time, we also classified 20 industries into 4 quadrants, and constructed 4 type of industry portfolios based on the 4 industry quadrants. Each portfolio consists of all the stocks in the industries listed in the corresponding quadrant. Following the same definitions as above, we have Trend-Following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

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

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

Portfolio Construction & Performance



This month, we find that Contrarian Long Portfolios initiated in June, July, August and September 2018 continue to outperform among others, while Contrarian Short Portfolios are having a hard time due to the market rally, except in those initiated in September. Contrarian Portfolios are more delicate to use due to their sensitivity to timing the expected reversal and exhibit very volatile performances, indicating that most of bubbles in the market are still dominating and that fundamentals have not yet played out. We expect trend-following positions to perform in the months following the position set-up and then contrarian positions to over-perform over longer time scales as the predicted corrections play out.

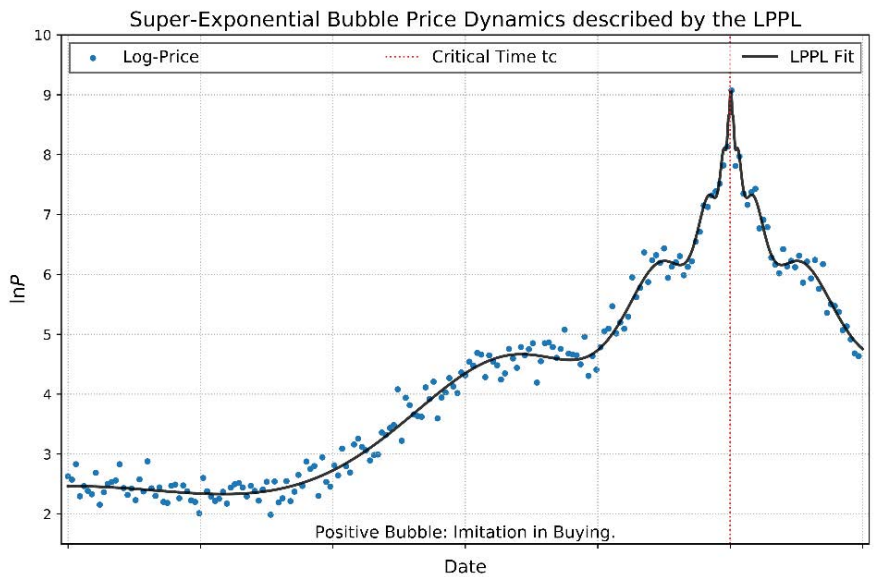
Appendix

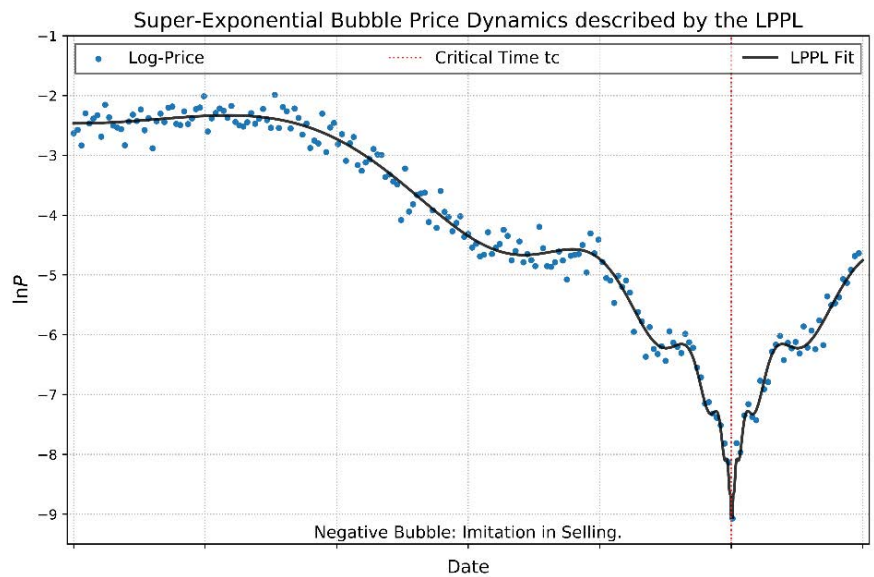
Methodology

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

1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.
2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in volatility towards the end of the bubble.
3. At the end of the bubble, the so-called critical time t_c, a finite time singularity occurs after which the bubble bursts.

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





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:

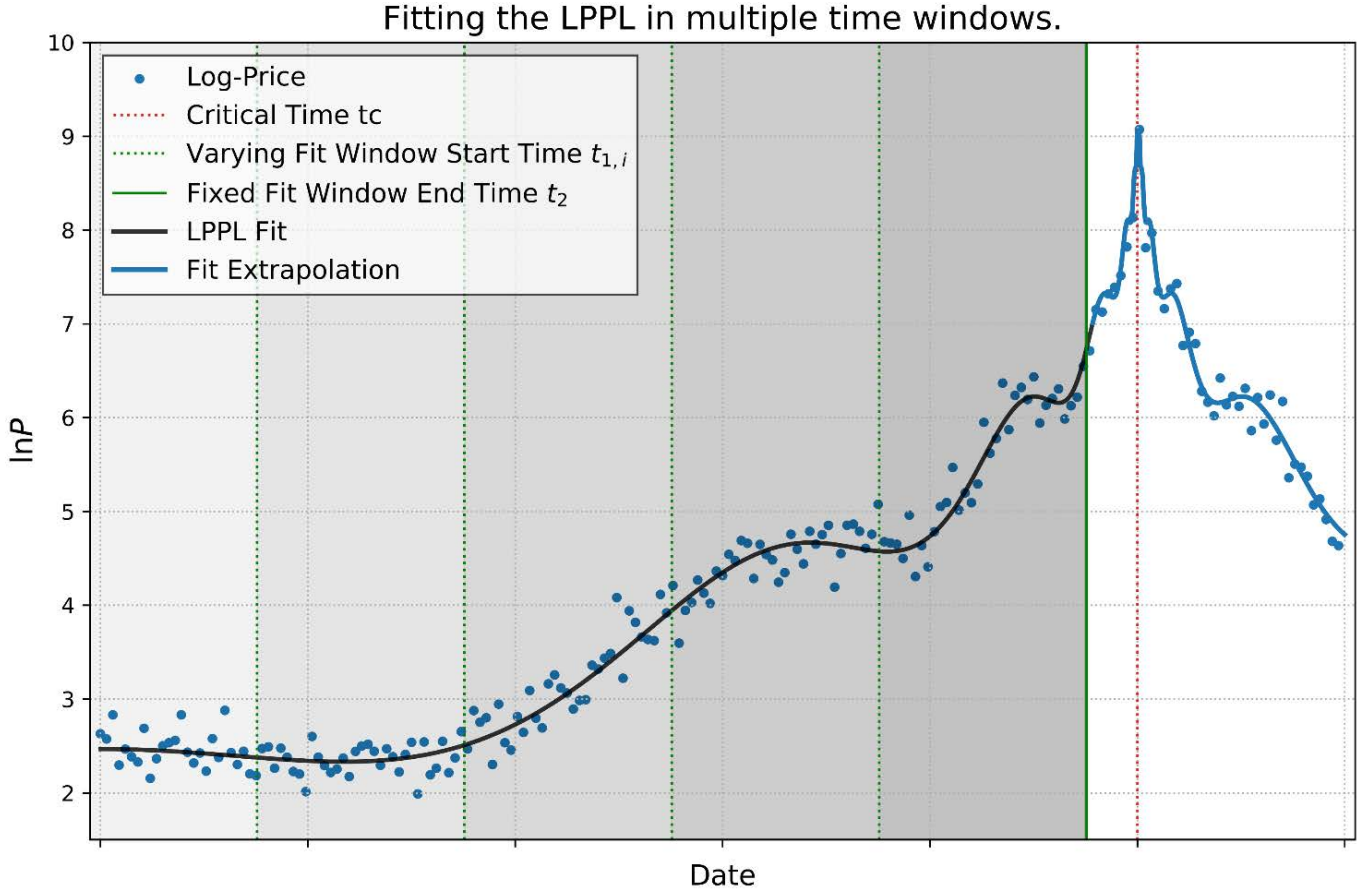
$$LPPLS \coloneqq E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$

The seven parameters describing the model dynamics are:

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

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

LPPLS Analysis of Price Time Series



In order to avoid overfitting and to continuously collect information about price dynamics, we scan asset log-price trajectories for super-exponential price dynamics by sequentially fitting the LPPLS model in different time windows to the underlying price series. The procedure is illustrated in the plot.
For a fixed fit window end time, t_2, we select different window start times $t_{1,i}$ and fit the LPPL model in each of the resulting windows. This gives one set of calibrated LPPL parameters per fit window. In our monthly report, t_2, the time of analysis is always the start of the month, i.e. the report date (1st July 2018 for the present report).

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 economiques de Bruxelles) 53 (2), 201-253 (summer 2010) and papers at http://www.er.ethz.ch/media/publications/social-systems-finance/bubbles_and_crashes_theory_empirical_analyses.html

K-means Clustering for Critical Time Prediction

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

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

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

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

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.

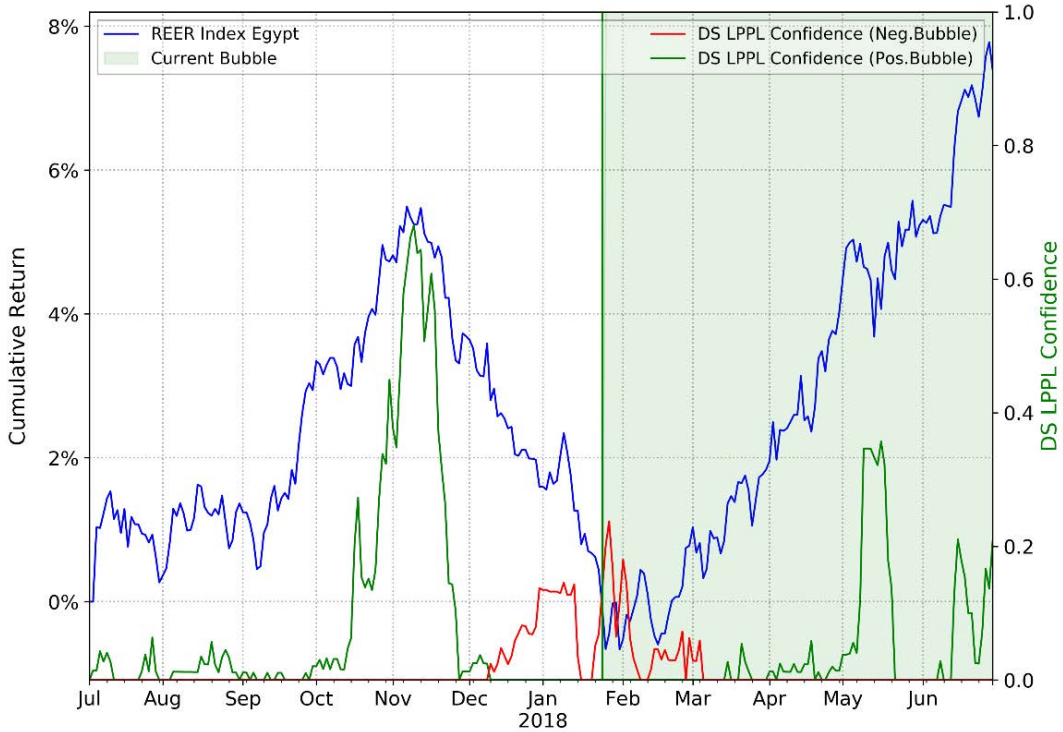
The first section provides asset and estimated bubble characteristics (size and duration), as well as the value of the confidence indicator. We rank assets according to their geometric average of the absolute of bubble size and confidence indicator. In this way, we incorporate the bubble size into the 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 μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	iBoxx GEMX Kenya Index	11	276	24	16	2018-07-19	19	62
Negative Bubbles								
1								

Result Presentation

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



Real Effective Exchange Rate Indices

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

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

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

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

Currencies – Principal Component Analysis

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

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

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

Value and Growth Score

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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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