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.

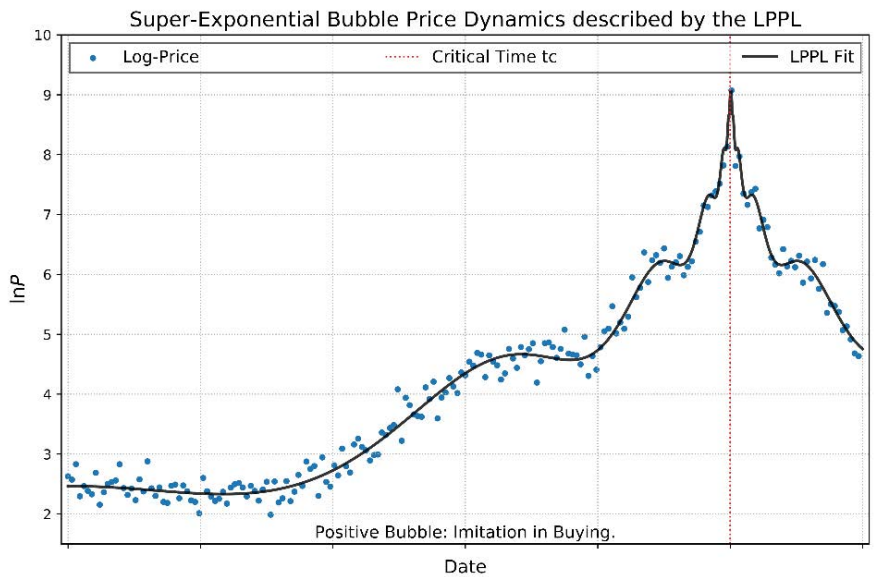
For an intuitive explanation of the methodology and the specifics of the indicators that are used in this report, we refer to: D. Sornette and P. Cauwels, Financial bubbles: mechanisms and diagnostics. Review of Behavioral Economics 2 (3), 279- 305 (2015)
http://arxiv.org/abs/1404.2140 and http://ssrn.com/abstract=2423790

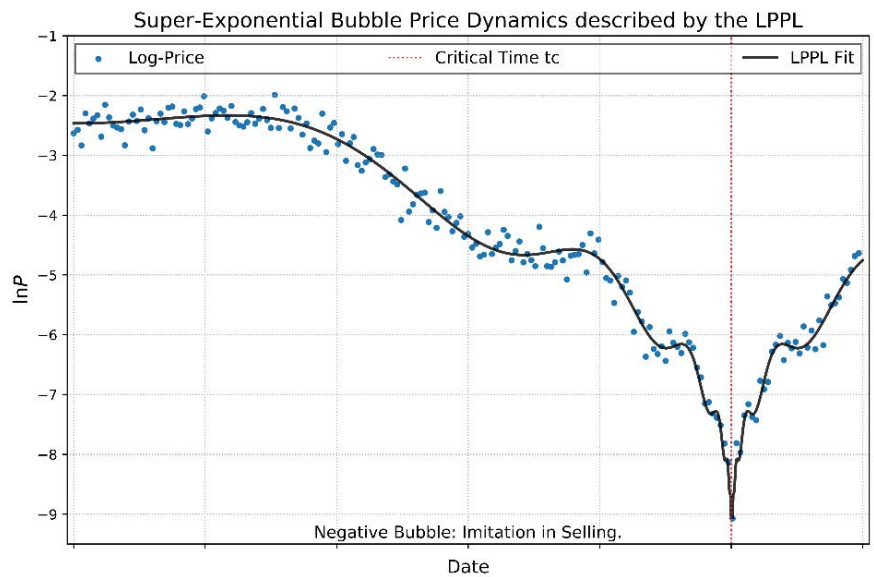
Methodology

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:

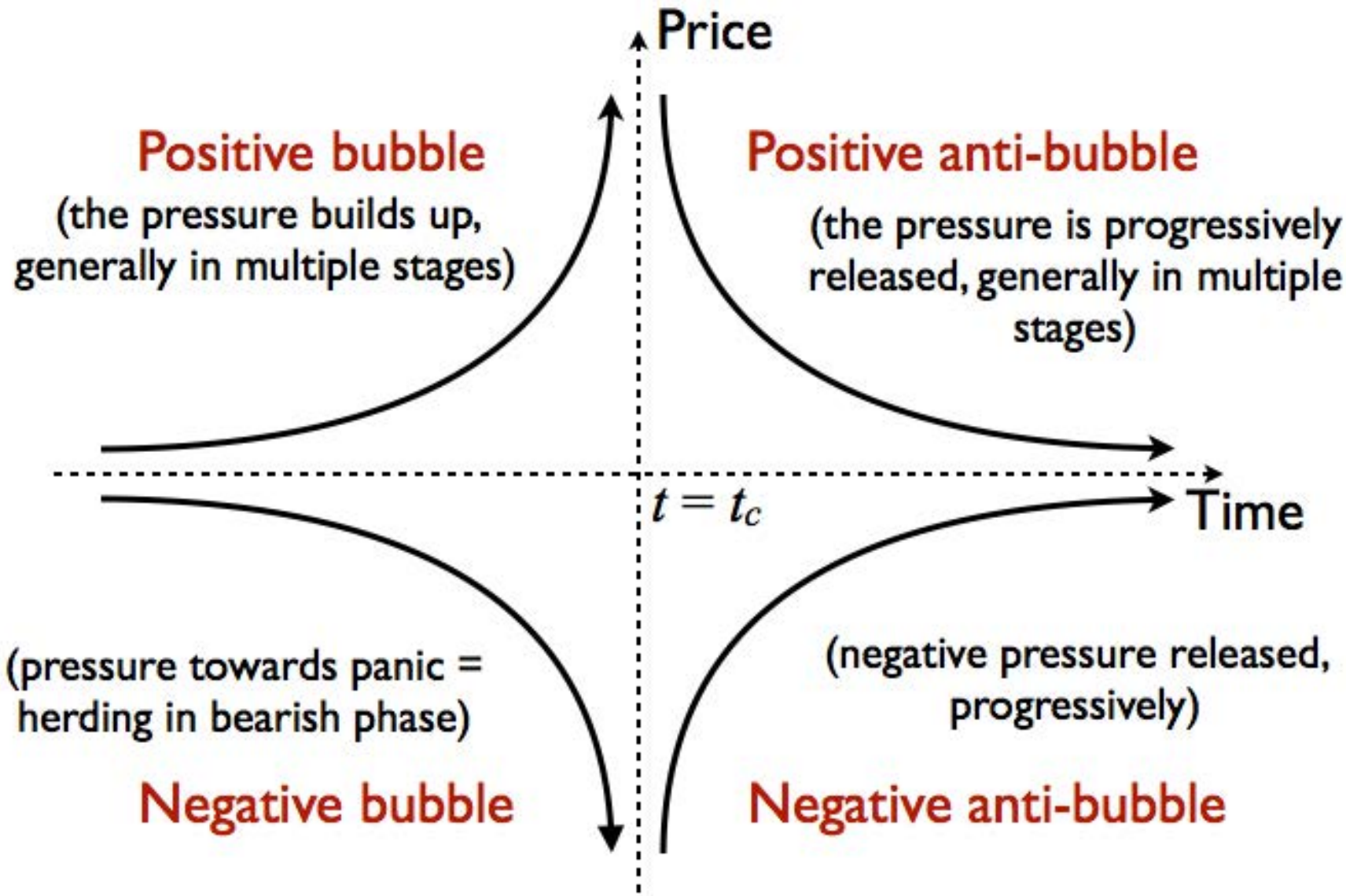
1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.
2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in 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.





Bubble Regimes



General Results – The Big Picture

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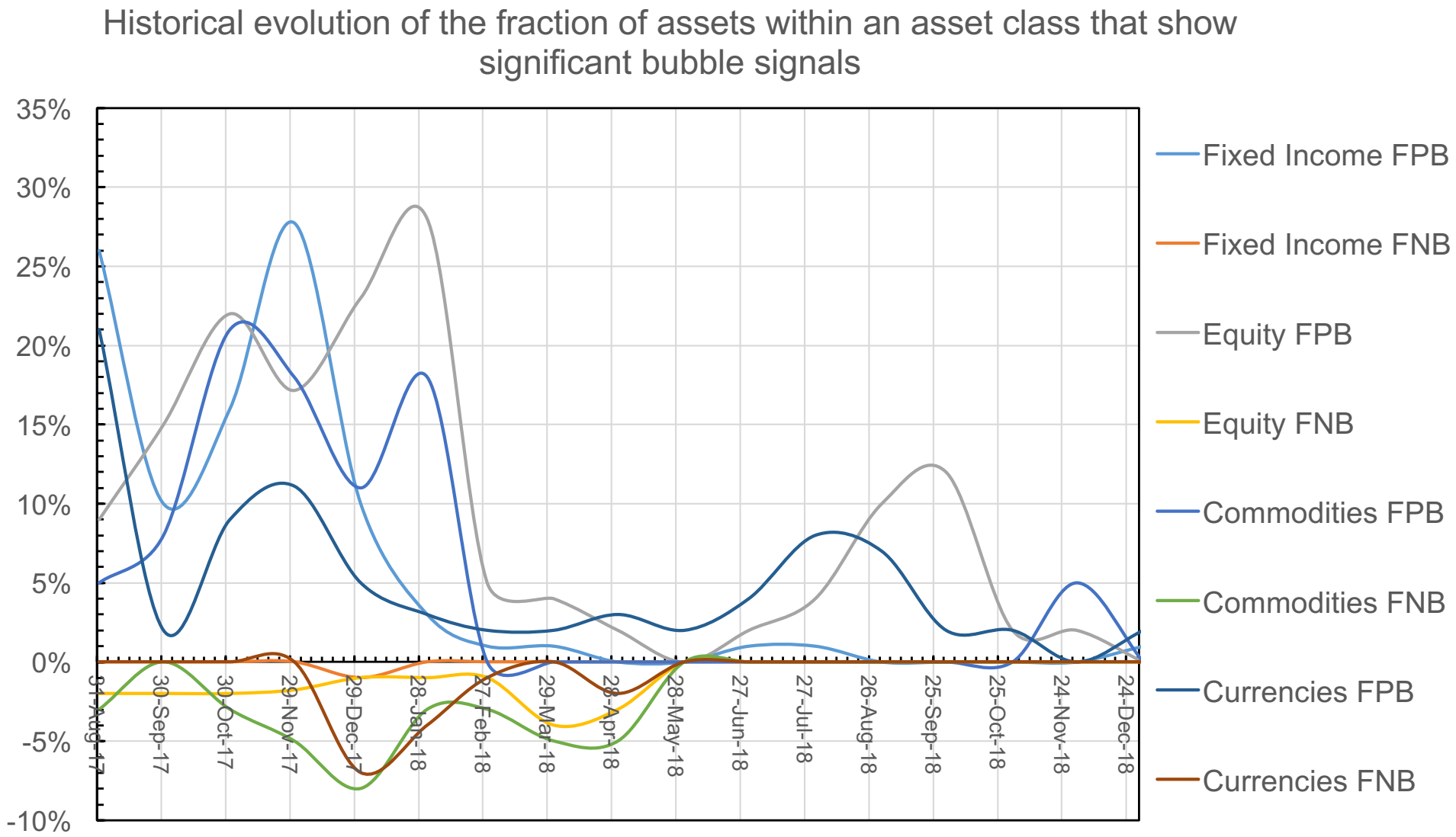

FPB – Fraction of Positive Bubbles, FNB – Fraction of Negative Bubbles

General Results – This Month's Overview

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Category	Analyzed Assets	Fraction of Pos. Bubbles [%]	Fraction of Neg. Bubbles [%]
Fixed Income	155	1	0
Government Bonds	55	4	0
Finance and Insurance	21	0	0
Corporate Bonds	79	0	0
Equity	218	0	0
Country Indices	67	1	0
Europe	35	0	0
United States	116	0	0
Commodities	30	0	0
Forex	53	2	0

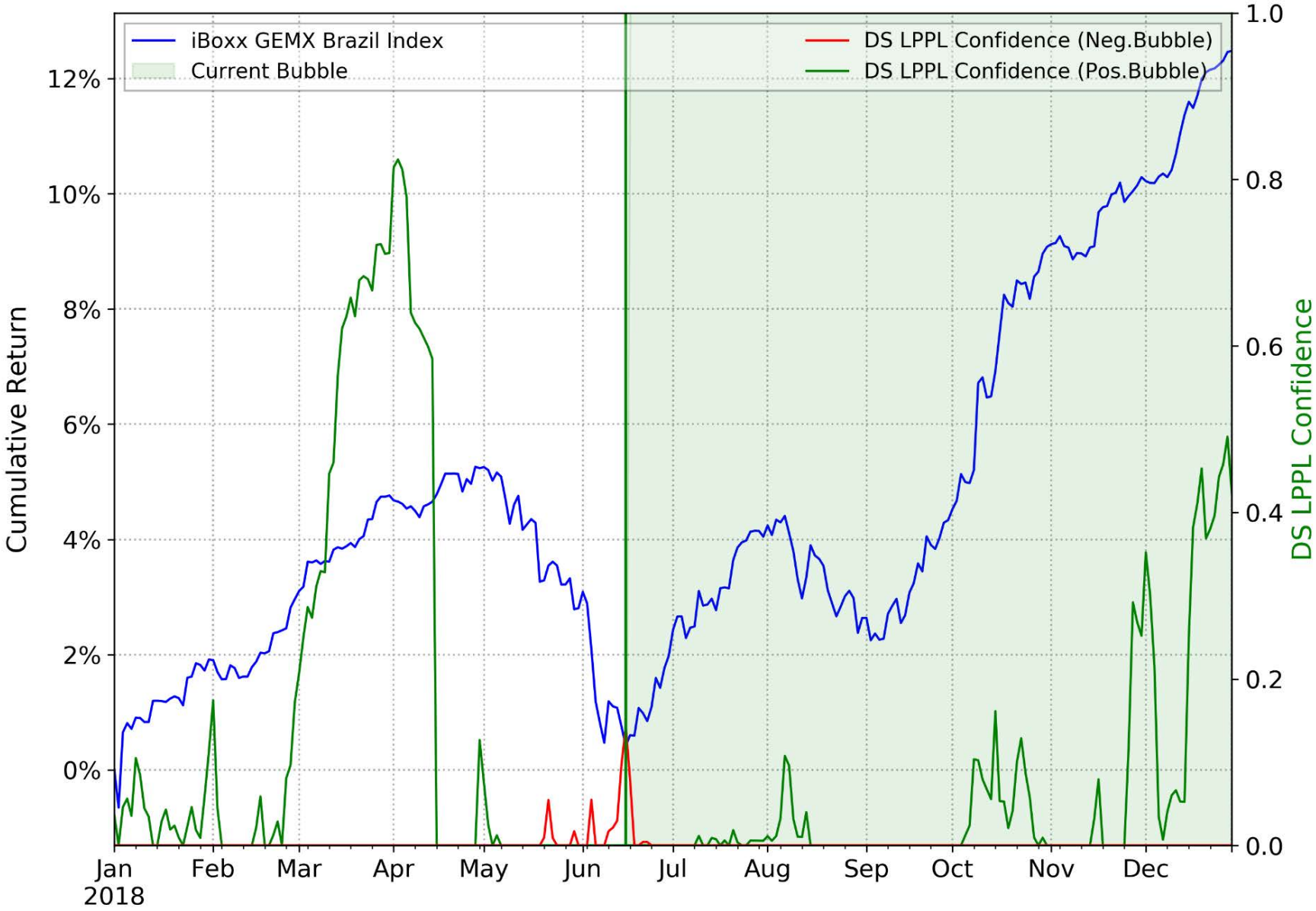
At the beginning of 2019, we witness extraordinarily calm markets with respect to bubbles' activity; detected bubble signals are at a low amongst all asset classes, as numerous markets have declined in value over the past year. Moreover, the declines themselves are not characteristic of negative bubbles. The lack of notable bubbles is likely to continue in 2019, as there are no major changes in the general economic situation that may give hope for or actually reintroduce a shift towards more self-reinforcing positive returns, yet.

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 μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	iBoxx GEMX Brazil Index	12	199	45	23	2019-01-12	12	91
2	iBoxx GEMX Kenya Index	10	261	21	15	2019-01-25	20	73

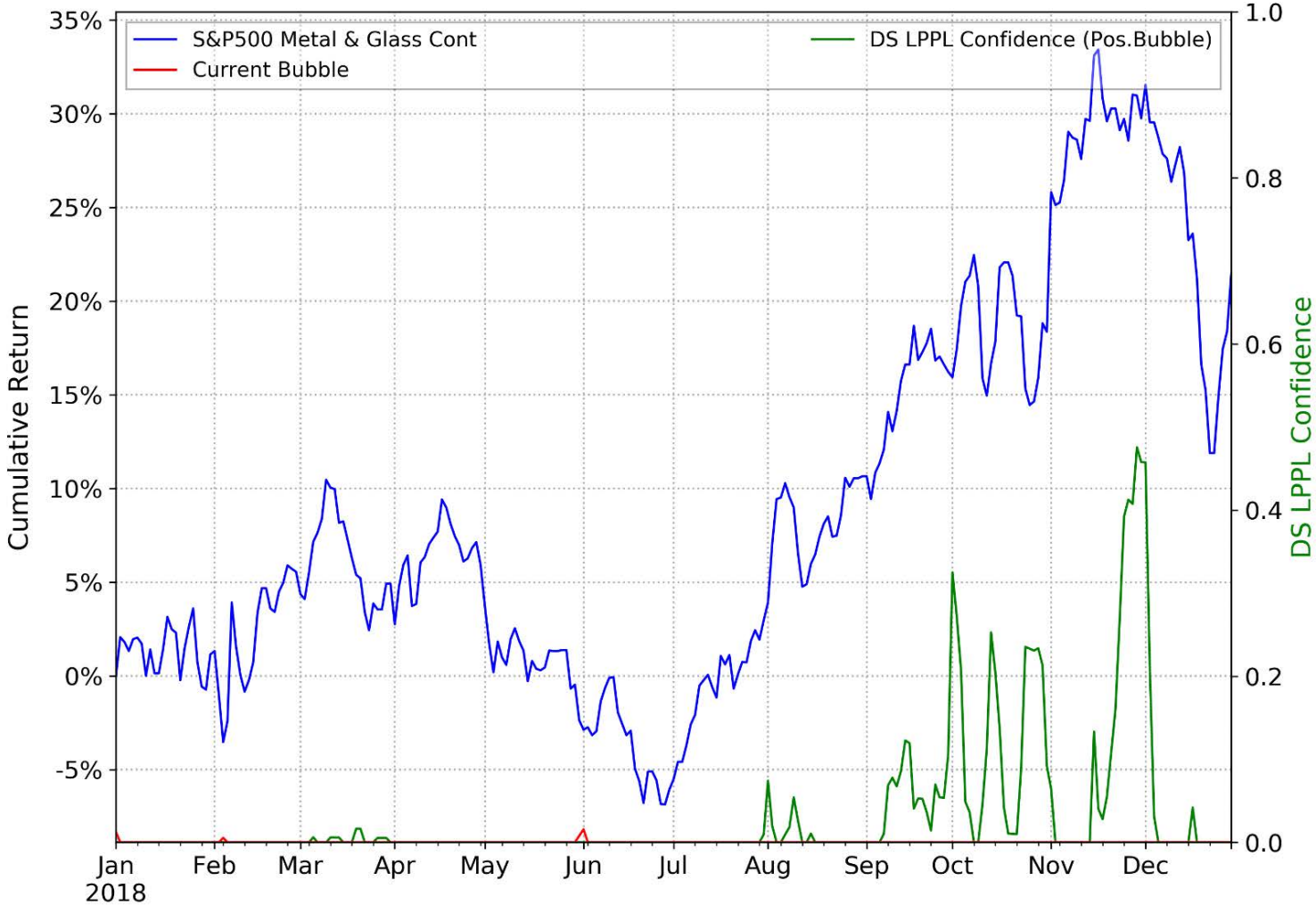
We find two government bond indices that fulfill the bubble filtering conditions of our procedure. The Brazilian and Kenyan GEMX Indices have both previously been mentioned in our report.

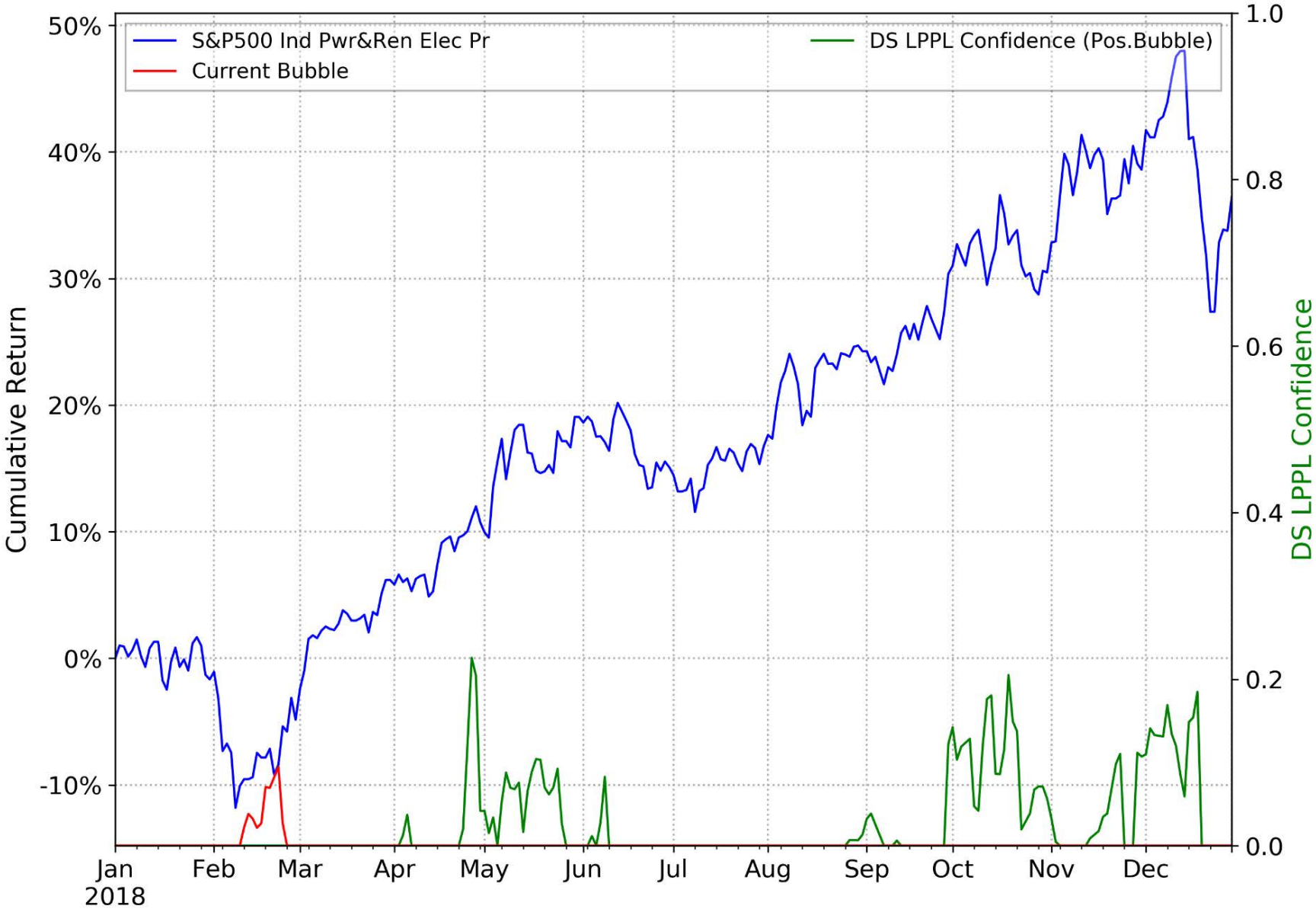
The Brazilian index, which is also depicted on the next slide has appreciated by more than 10% from a local trough reached in mid June 2018. Currently, the detected fraction of positive bubble signals in the LPPLS analysis of this index, in other words the DS LPPLS Confidence Indicator, is at an intermediate level of 45%. The most probable predicted bubble scenario is found at a high probability of 91%. The reported critical time is characterized by a significant standard deviation of more than 10 days standard deviation. We interpret this situation by projecting a continuation of the rise for the next month, and the possibility of a change of regime thereafter will be monitored.

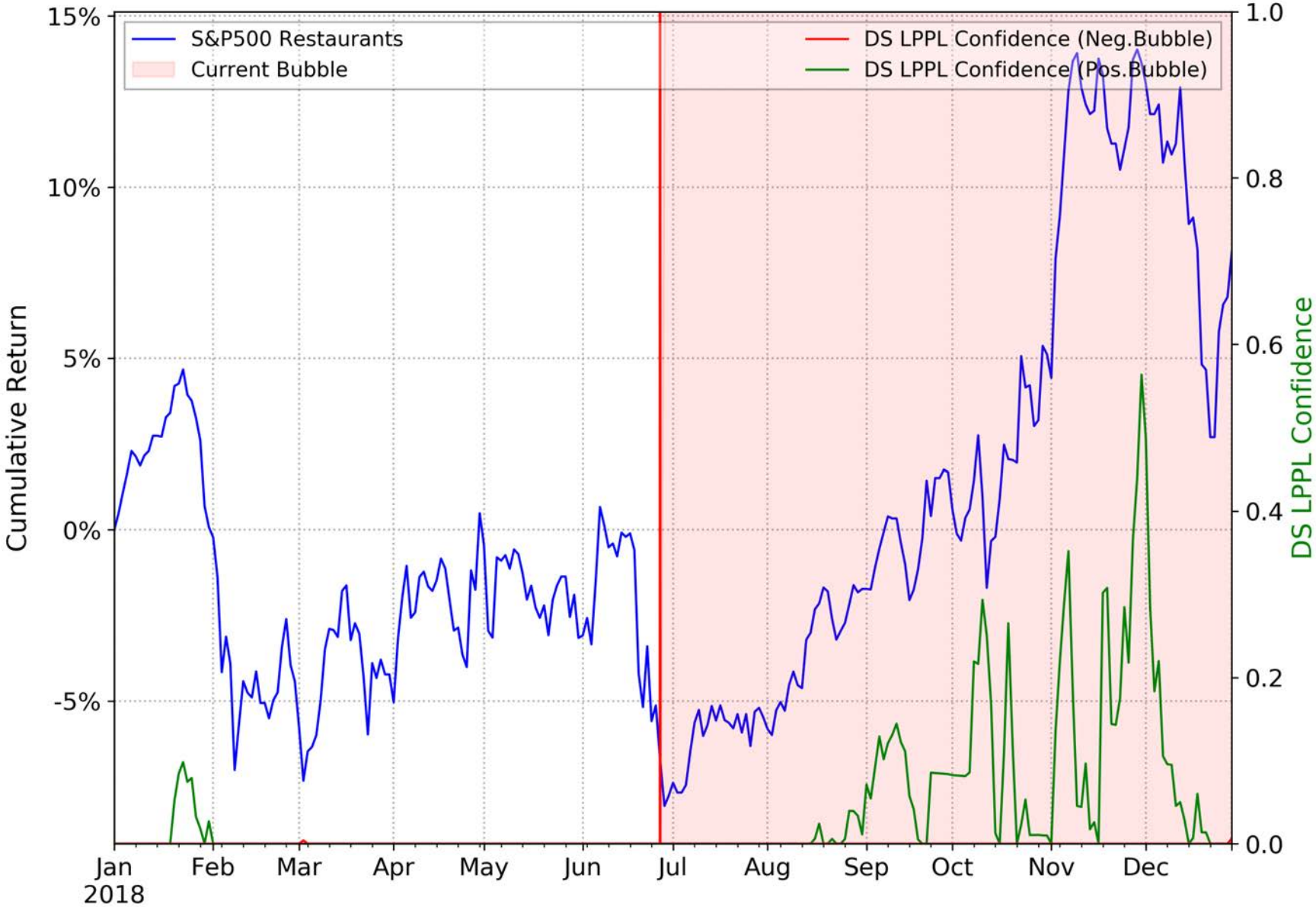

iBoxx GEMX Brazil Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
12%
10%
8%
6%
4%
2%
0%
1.0
0.8
0.6
0.4
0.2
0.0
Jan 2018
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Equities – United States Indices

There are no bubble signals to show in this section this month. However, we would like to point out that major drawdowns have occurred on the three indices that were presented for this asset class in the previous month's report. Notice the nice peak of the DS LPPL confidence indicator, coinciding with the start of the correction.

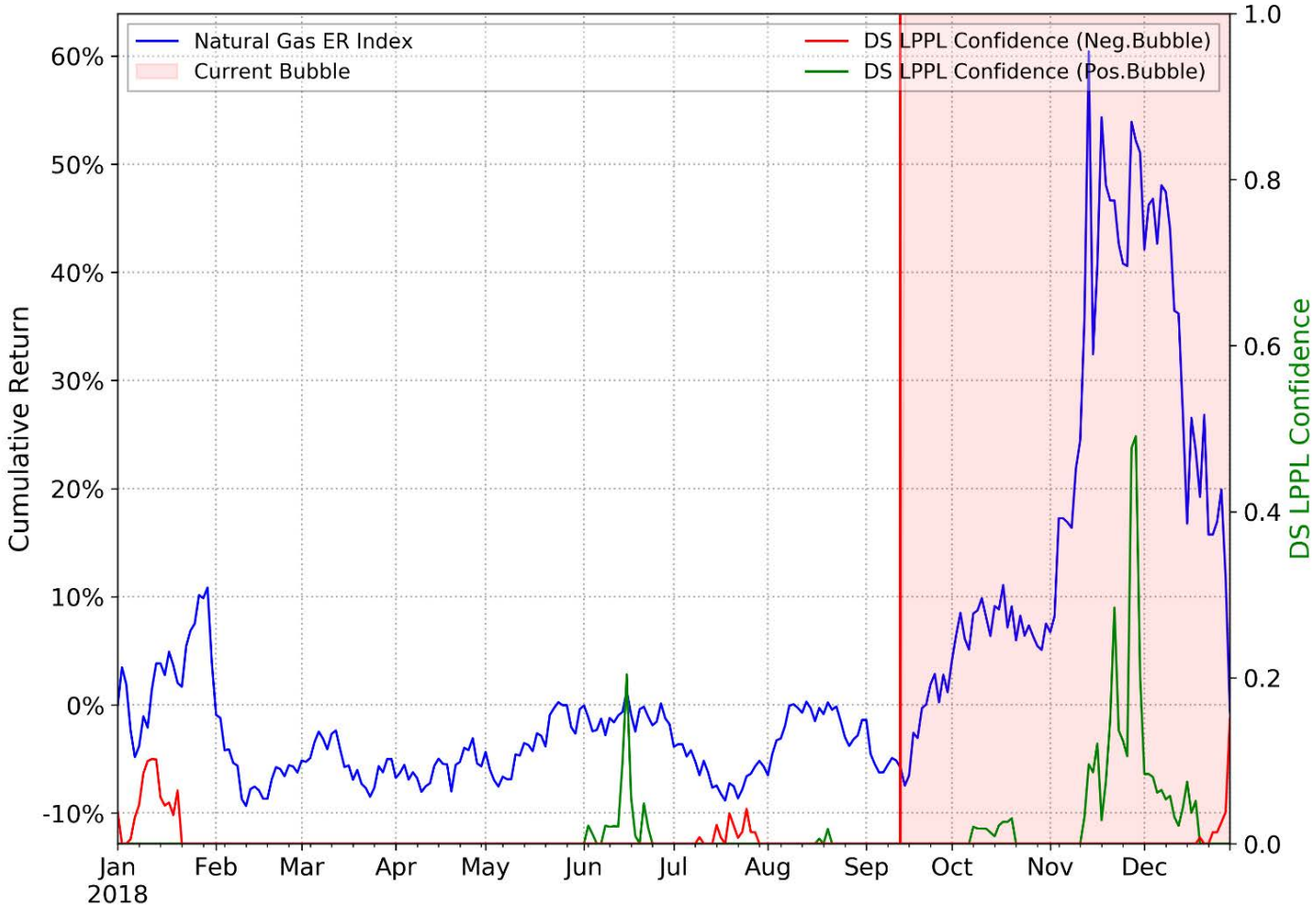



S&P500 Ind Pwr&Ren Elec Pr
Current Bubble
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
50%
40%
30%
20%
10%
0%
-10%
1.0
0.8
0.6
0.4
0.2
0.0
Jan
2018
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


S&P500 Restaurants
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
15%
10%
5%
0%
-5%
1.0
0.8
0.6
0.4
0.2
0.0
Jan 2018
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Commodities

Another example that was discussed in more detail in the previous report is given by the Natural Gas index. One month ago, a giant rise in the gases price could be observed due to a number of events and speculations. The strong rally in the price of the commodity fueled immense instability. Now, one month later, we can see that the price has collapsed nearly as fast and as intensely as it shot up!



Currencies

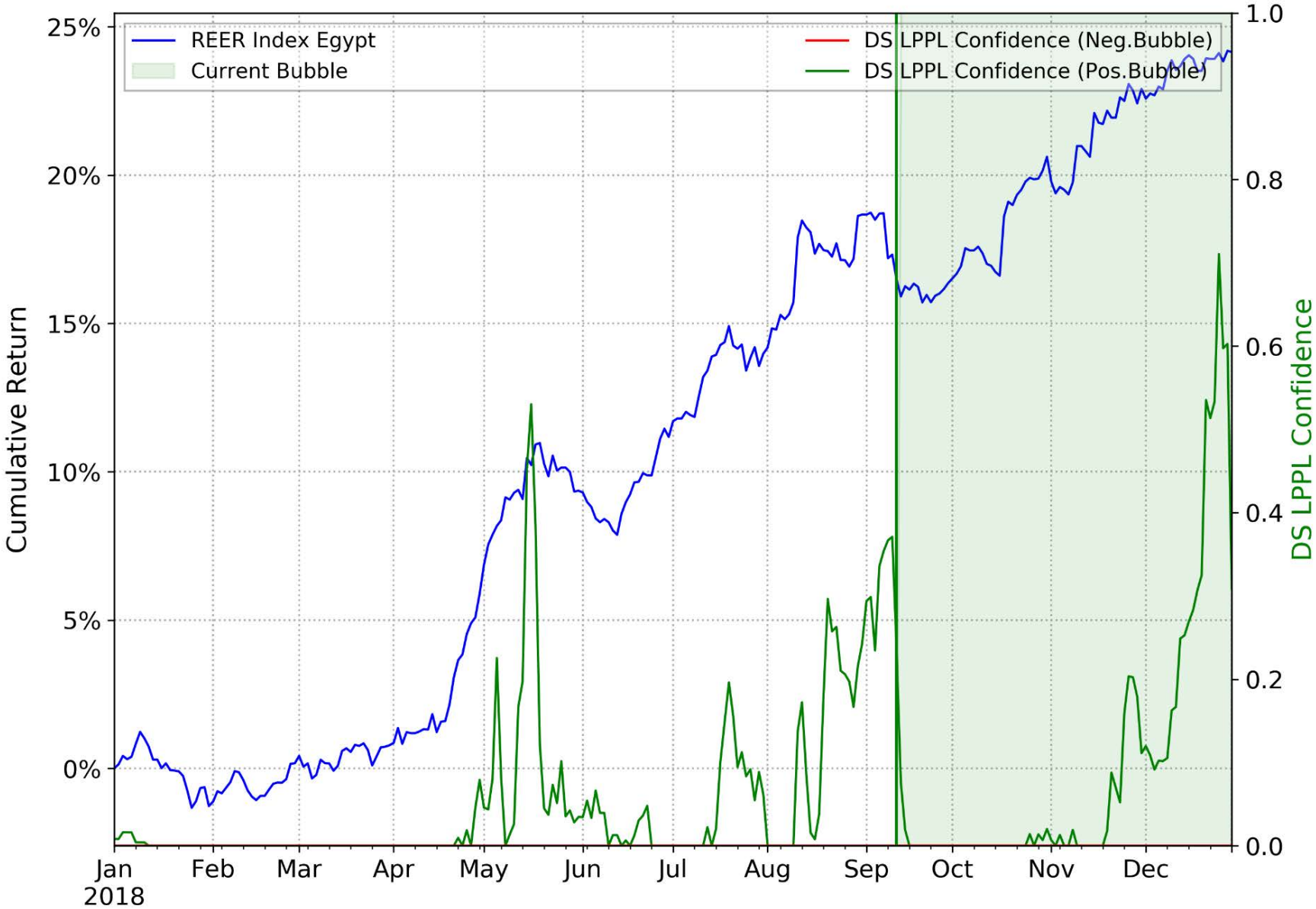
	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	REER Index Egypt	15	240	22	18	2019-01-05	9	43

We find only the Real Effective Exchange Rate (REER) Index Egypt on the list of detected positive bubbles in the currency sector. All indicator levels are at low to intermediate levels; the corresponding plot is depicted on the next slide.

Also shown are the results of the monthly currency pair Principal Component Analysis (PCA). Application of the LPPLS bubble detection framework did not reveal any hidden bubble activity this month, similarly as in previous months.

The cryptocurrency market is still lurching in the bearish regime with no sign of a recovery, yet. Concerning Bitcoin, the current bear market is about to become the longest in its (relatively short-lived) history with more than one year duration. For more on the history of the Bitcoin price and its bubbles, we refer to our 2018 study [1].

[1] Gerlach, Demos and Sornette (2018). https://ssrn.com/abstract=3164246


REER Index Egypt
Current Bubble
DS LPPL Confidence (Neg.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
Jan 2018
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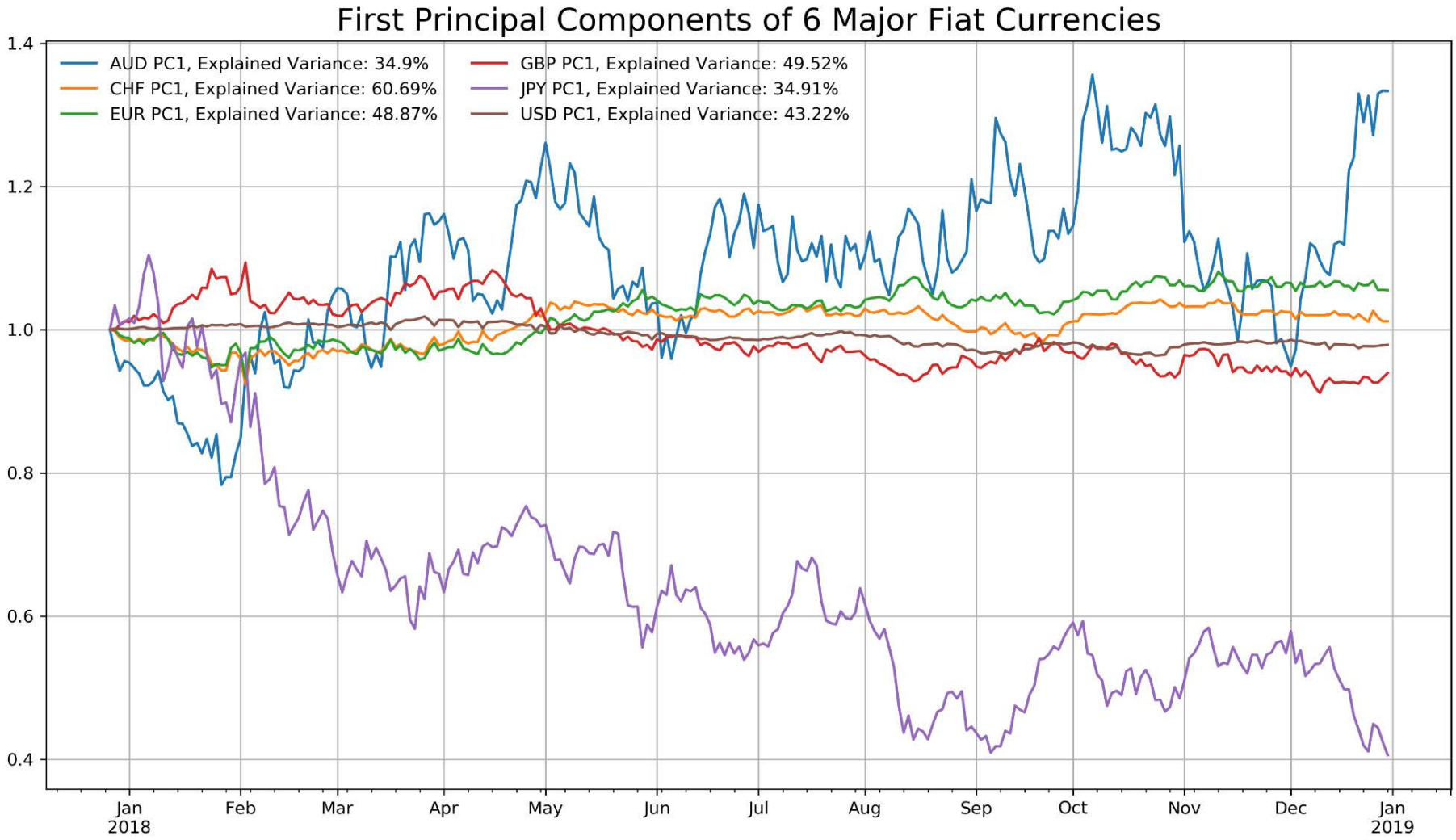
Nov
Dec

Currencies – PCA



Single Stocks

For 820 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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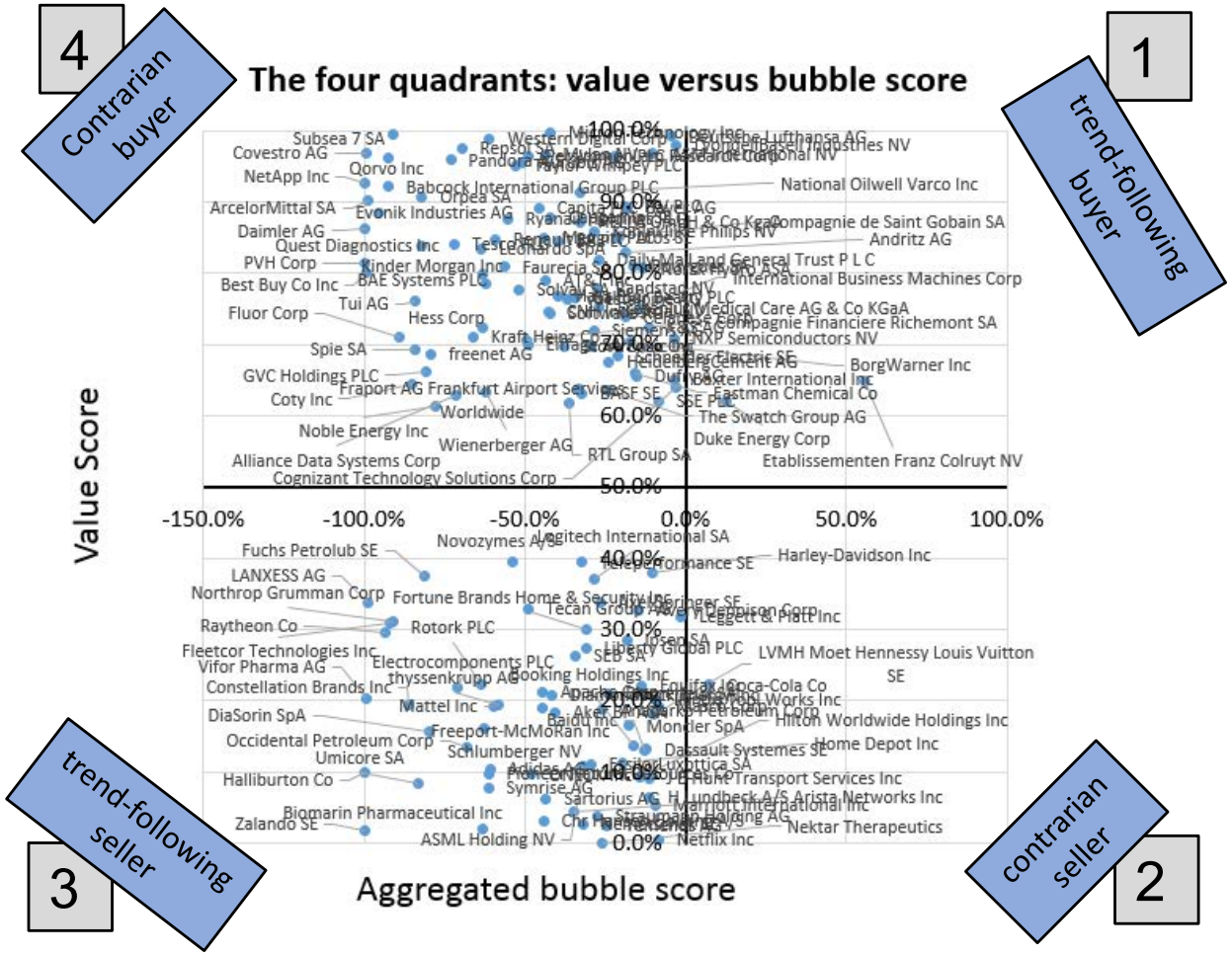
To analyze the financial strength of individual stocks, we have two indicators. Both scores give a value between zero and one, one being the best of the set and zero the worst, so the higher the score, the higher the financial strength.

- 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. Duke Energy Corp);
2. Quadrant 2: Stocks with a strong positive bubble score and a weak value score (e.g. Coca-Cola Co);
3. Quadrant 3: Stocks with a strong negative bubble score and a weak value score (e.g. Zalando SE);
4. Quadrant 4: Stocks with strong negative bubble score and a strong financial strength (e.g. Tui 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.

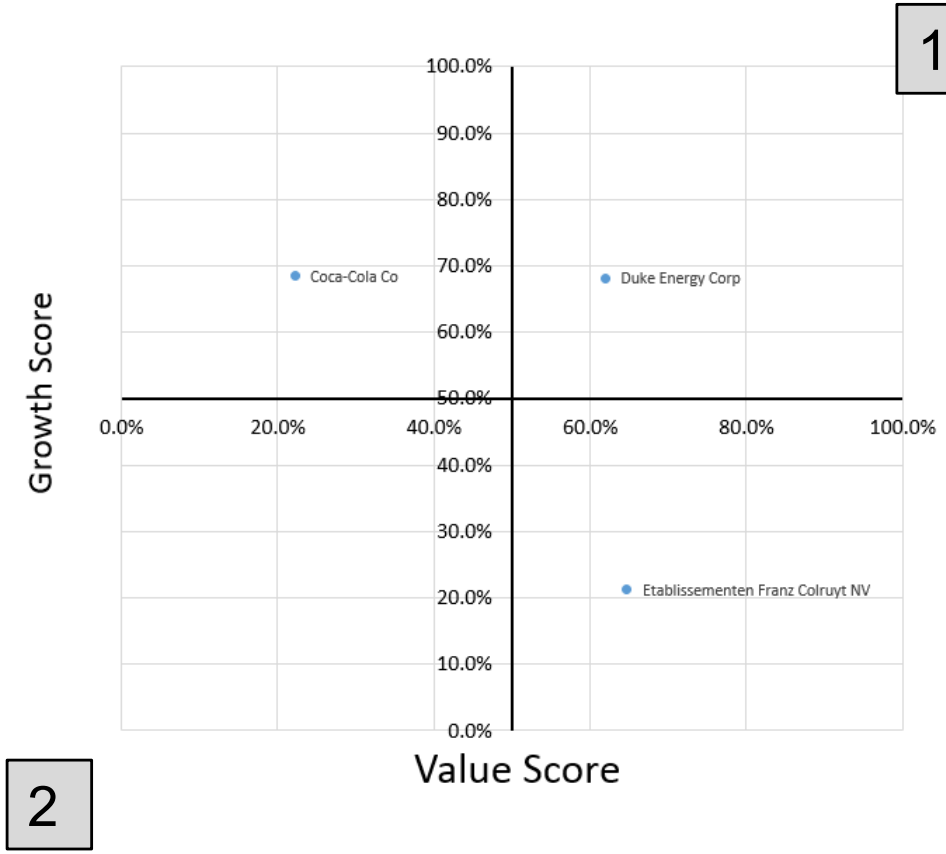
3. Quadrant 3: These stocks are expensive relative to their earnings potential. On top of that, there are clear negative bubble signals. Such stocks should be considered as falling knives. As an investor, one could be a trend-following seller.

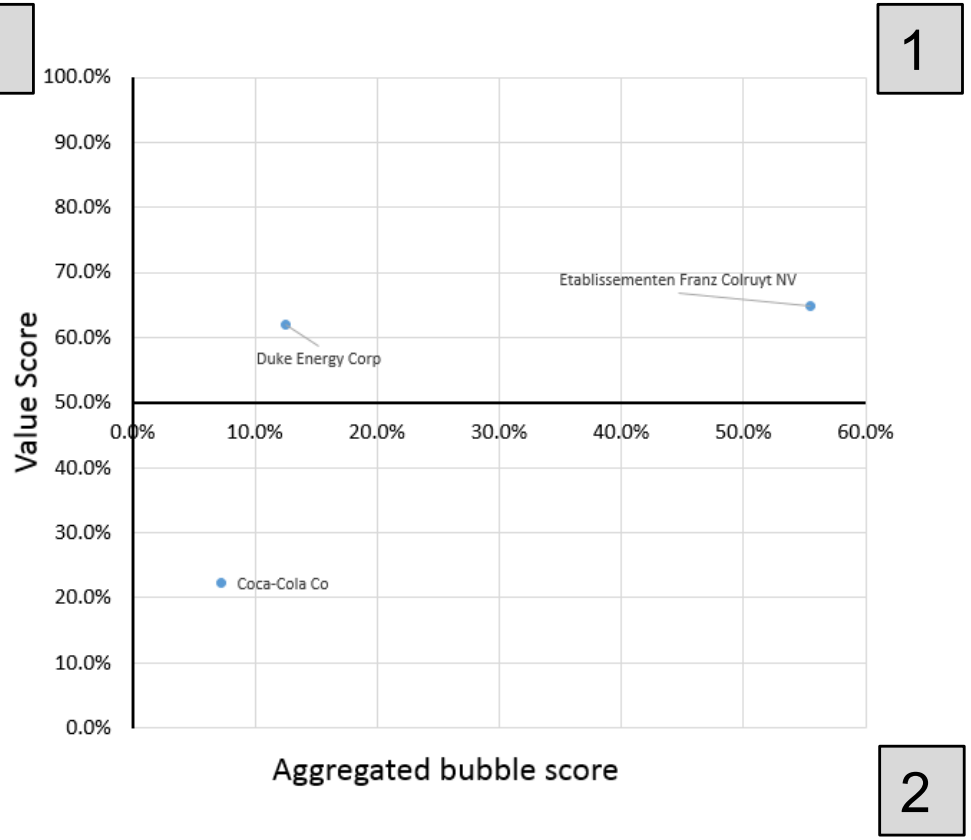
4. Quadrant 4: These stocks are cheap relative to their financial performance. The strong negative bubble signal is an indication of sentiment and herding. These stocks can be considered as over-sold. As an investor, one could be a contrarian buyer.

Single Stocks

Quadrant 1 and 2 stocks

Strong positive bubble signals with strong (respectively weak) fundamentals

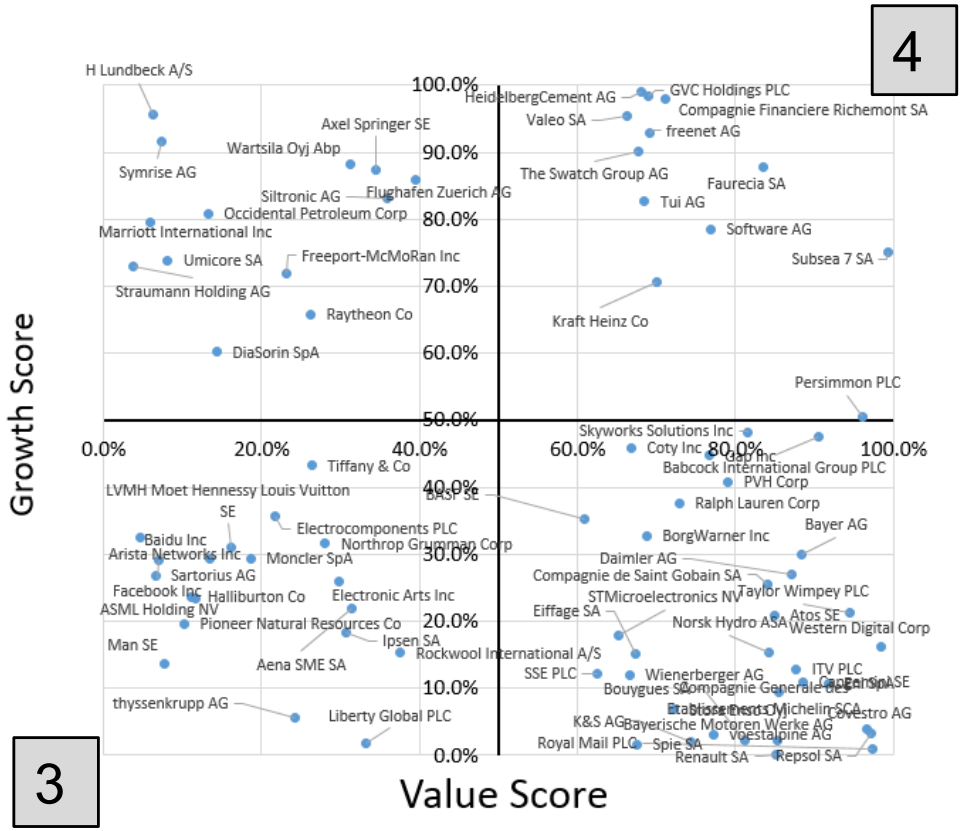


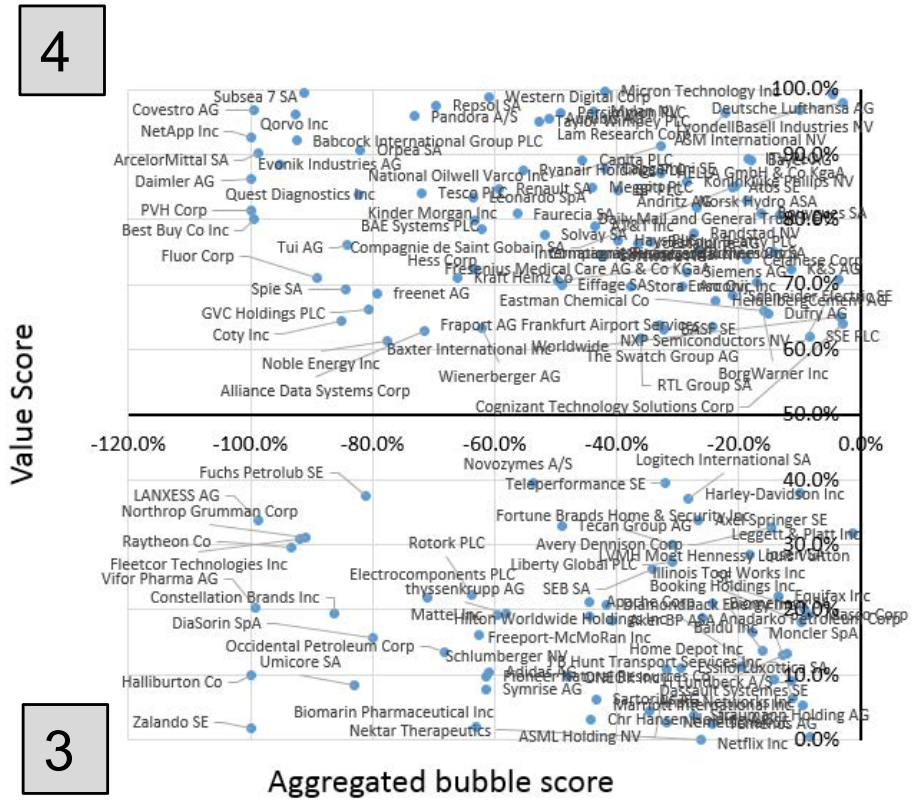


Single Stocks

Quadrant 3 and 4 stocks

Strong negative bubble signals with weak (respectively strong) fundamentals





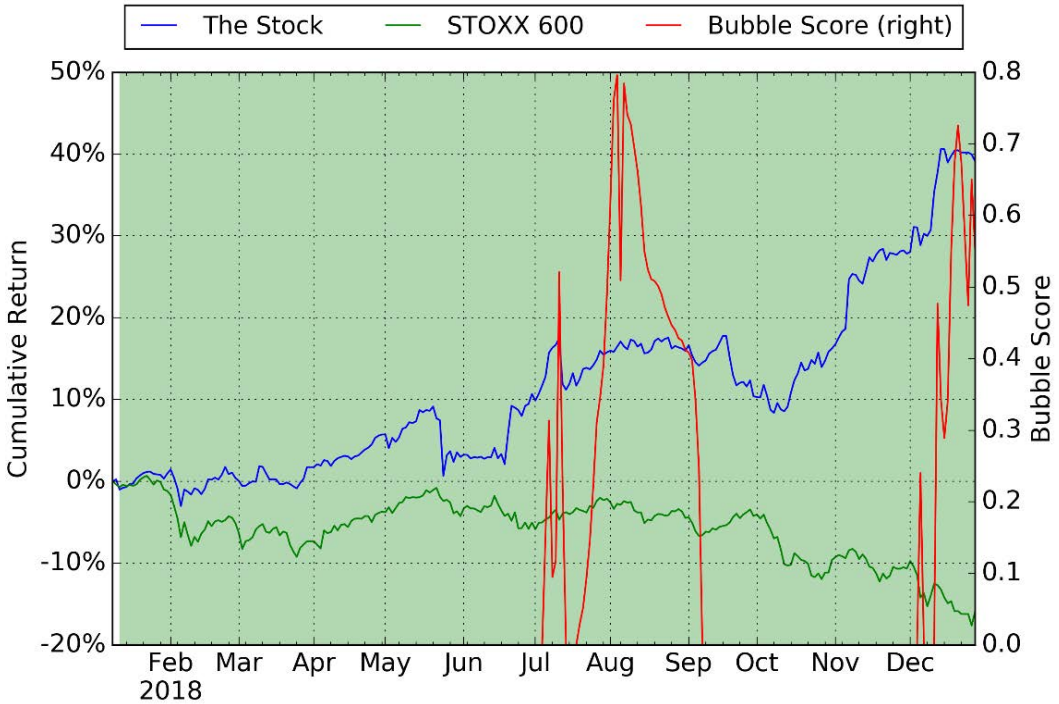
Single Stocks

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
Etablissementen Franz Colruyt NV	Belgium	Food & Staples Retailing	40.6%	40.6%	Jan-18	55.5%	64.8%	21.2%
Duke Energy Corp	United States of America	Utilities	8.6%	12.1%	Feb-18	12.5%	62.0%	68.0%

Single Stocks - Quadrant 1 stocks

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals
Example: Etablissementen Franz Colruyt NV.

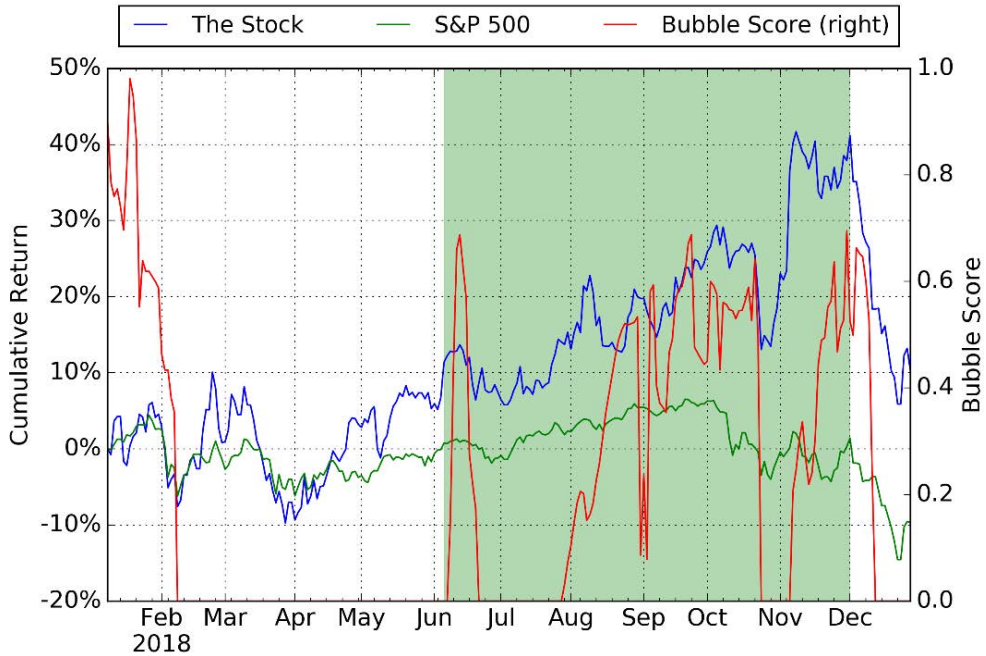


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this one year bubble has reached 55.5% with a bubble size 40.6%.

Single Stocks - Quadrant 1 stocks

Last month example: strong positive bubble signals with strong fundamentals, Mosaic Co.

The figure below plots the one year cumulative return of the stock (blue), S&P 500 (green) and LPPLS Bubble Score (red lines on the right y-axis). The green shaded period is the strong positive bubble we identified and reported last month. Note that the stock has a huge correction of 30% in the past month, which is in agreement with the DS LPPLS indicator of a change of regime, but not with the strong fundamentals.



Single Stocks - Quadrant 2 stocks

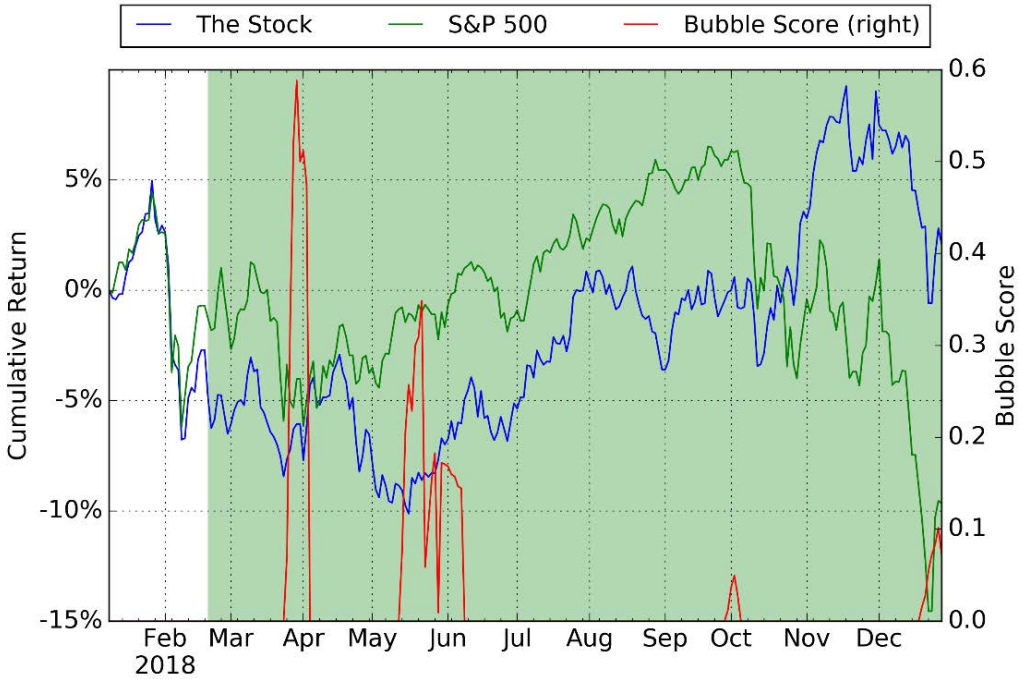
Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Coca-Cola Co	United States of America	Food, Beverage & Tobacco	2.5%	7.3%	Feb-18	7.2%	22.2%	68.4%

Single Stocks - Quadrant 2 stocks

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals

Example: Coca-Cola Co.

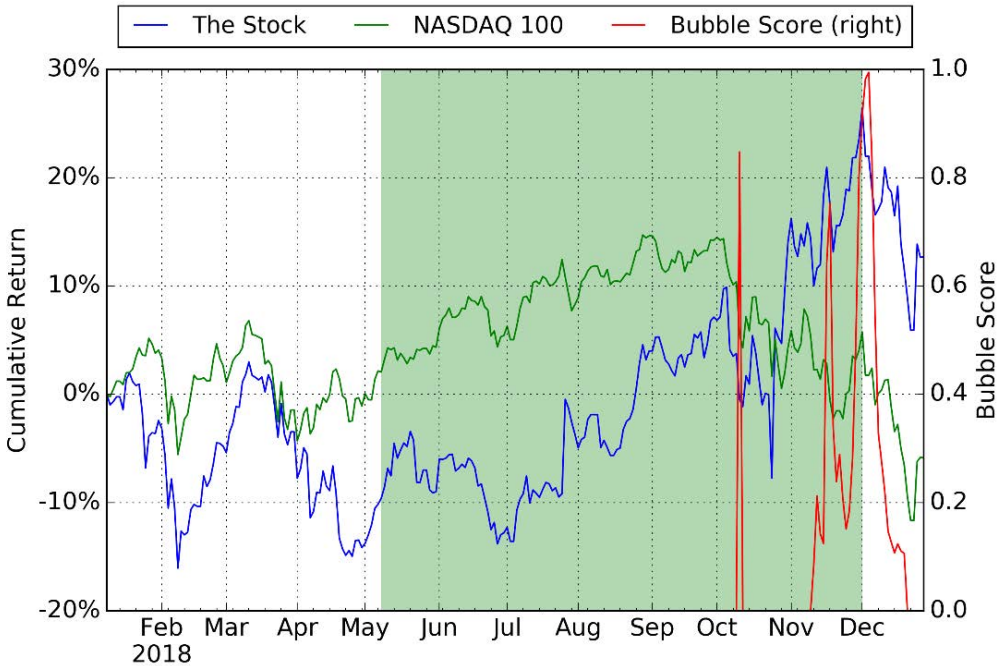


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the positive bubble we identified. The Bubble Score of this ten month bubble has reached 7.2% with a bubble size 7.3%. We consider this positive bubble is at a early stage, which may continue to develop, or stop due to the weak fundamentals.

Single Stocks - Quadrant 2 stocks

Last month example: strong positive bubble signals with weak fundamentals, Xilinx Inc.

The figure below plots the one year cumulative return of the stock (blue), NASDAQ 100 (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 had a strong correction in the past month, which is 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
ASML Holding NV	Netherlands	Semiconductors & Semiconductor Equipment	-13.1%	-27.4%	Jun-18	-31.8%	10.9%	23.3%
Baidu Inc	China	Media & Entertainment	-35.2%	-38.5%	Jun-18	-12.9%	13.0%	27.2%
Booking Holdings Inc	United States of America	Retailing	-9.4%	-17.7%	Mar-18	-16.0%	13.7%	35.2%
Biomarin Pharmaceutical Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	-7.1%	-19.1%	Jul-18	-63.0%	2.0%	90.4%
Diamondback Energy Inc	United States of America	Energy	-29.3%	-30.4%	Jul-18	-41.7%	20.7%	20.4%
J B Hunt Transport Services Inc	United States of America	Transportation	-22.9%	-24.8%	Jun-18	-11.4%	9.0%	77.7%
Liberty Global PLC	United Kingdom	Media & Entertainment	-41.8%	-27.9%	May-18	-31.0%	27.4%	1.1%
Marriott International Inc	United States of America	Consumer Services	-23.1%	-18.0%	Jul-18	-9.5%	5.4%	79.8%
Mattel Inc	United States of America	Consumer Durables & Apparel	-35.8%	-41.6%	Jun-18	-59.5%	19.3%	99.9%
Netflix Inc	United States of America	Media & Entertainment	17.9%	-36.8%	Jun-18	-8.4%	0.5%	68.2%
Nektar Therapeutics	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	-51.9%	-67.3%	Mar-18	-26.1%	0.0%	13.4%
Umicore SA	Belgium	Materials	-20.9%	-33.4%	Jul-18	-83.0%	8.4%	74.1%
Adidas AG	Germany	Consumer Durables & Apparel	9.6%	-12.5%	Aug-18	-60.9%	10.4%	92.2%
Fuchs Petrolub SE	Germany	Materials	-18.6%	-26.8%	Aug-18	-81.0%	37.4%	41.3%
LANXESS AG	Germany	Materials	-41.7%	-42.5%	Jul-18	-98.7%	33.7%	12.9%
Nemetschek SE	Germany	Software & Services	22.4%	-22.8%	Aug-18	-31.9%	2.7%	37.4%
Axel Springer SE	Germany	Media & Entertainment	-26.5%	-27.6%	Jan-18	-26.6%	33.8%	87.6%
Sartorius AG	Germany	Health Care Equipment & Services	23.5%	-23.3%	Jul-18	-43.3%	6.2%	27.7%
Symrise AG	Germany	Materials	-6.8%	-17.9%	Jul-18	-61.3%	7.8%	91.6%
thyssenkrupp AG	Germany	Materials	-40.7%	-32.1%	Jun-18	-58.2%	19.4%	3.2%
Zalando SE	Germany	Retailing	-49.6%	-50.5%	Aug-18	-100.0%	1.8%	40.4%

Single Stocks - Quadrant 3 stocks

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Quadrant 3 stocks: strong negative bubble signals with weak fundamentals (cont'd)

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Moncler SpA	Italy	Consumer Durables & Apparel	14.8%	-29.2%	Jun-18	-17.8%	16.5%	30.7%
Aker BP ASA	Norway	Energy	2.6%	-28.7%	Jun-18	-40.6%	18.4%	29.8%
Rotork PLC	United Kingdom	Capital Goods	-14.2%	-27.9%	Jul-18	-63.6%	22.3%	45.0%
Logitech International SA	Switzerland	Technology Hardware & Equipment	-9.1%	-27.9%	Jun-18	-28.3%	37.0%	18.4%
Straumann Holding AG	Switzerland	Health Care Equipment & Services	-11.4%	-17.6%	Jun-18	-27.4%	3.8%	72.7%
Tecan Group AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	-6.6%	-19.8%	Jun-18	-49.1%	32.8%	85.4%
Temenos AG	Switzerland	Software & Services	-7.9%	-24.1%	Jul-18	-24.4%	2.4%	70.2%
Vifor Pharma AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	-22.0%	-43.9%	Jul-18	-99.2%	20.4%	91.7%
Arista Networks Inc	United States of America	Technology Hardware & Equipment	-21.1%	-25.1%	Jun-18	-34.7%	4.4%	31.1%
Apache Corp	United States of America	Energy	-42.7%	-43.8%	Jul-18	-44.5%	21.2%	17.9%
Anadarko Petroleum Corp	United States of America	Energy	-26.2%	-41.4%	Jul-18	-26.0%	18.7%	11.1%
Avery Dennison Corp	United States of America	Materials	-25.7%	-16.5%	Apr-18	-14.6%	32.7%	42.9%
Equifax Inc	United States of America	Commercial & Professional Services	-23.6%	-25.6%	Jun-18	-13.6%	22.1%	50.4%
Chr Hansen Holding A/S	Denmark	Materials	-0.3%	-13.3%	Jul-18	-44.2%	3.0%	74.9%
H Lundbeck A/S	Denmark	Pharmaceuticals, Biotechnology & Life Sciences	-9.3%	-30.6%	May-18	-11.1%	6.5%	94.6%
Novozymes A/S	Denmark	Materials	-14.5%	-15.1%	Aug-18	-53.7%	39.5%	82.7%
Electrocomponents PLC	United Kingdom	Technology Hardware & Equipment	-17.9%	-32.0%	Aug-18	-71.1%	22.0%	36.8%
Biomerieux SA	France	Health Care Equipment & Services	-29.4%	-27.3%	Jun-18	-24.3%	21.0%	80.5%
Dassault Systemes SE	France	Software & Services	11.7%	-6.2%	Mar-18	-12.2%	13.2%	33.8%
EssilorLuxottica SA	France	Consumer Durables & Apparel	-0.9%	-13.6%	Jul-18	-29.4%	11.0%	81.1%
Ipsen SA	France	Pharmaceuticals, Biotechnology & Life Sciences	5.2%	-16.4%	Apr-18	-18.3%	28.4%	18.0%
LVMH Moet Hennessy Louis Vuitton SE	France	Consumer Durables & Apparel	5.8%	-14.6%	Jul-18	-9.7%	18.2%	33.5%
Teleperformance SE	France	Commercial & Professional Services	8.7%	-13.7%	Jul-18	-32.1%	39.4%	95.1%
SEB SA	France	Consumer Durables & Apparel	-32.9%	-30.5%	May-18	-34.1%	26.2%	89.3%
DiaSorin SpA	Italy	Health Care Equipment & Services	-11.2%	-27.6%	Jun-18	-79.9%	15.6%	60.5%

Single Stocks - Quadrant 3 stocks

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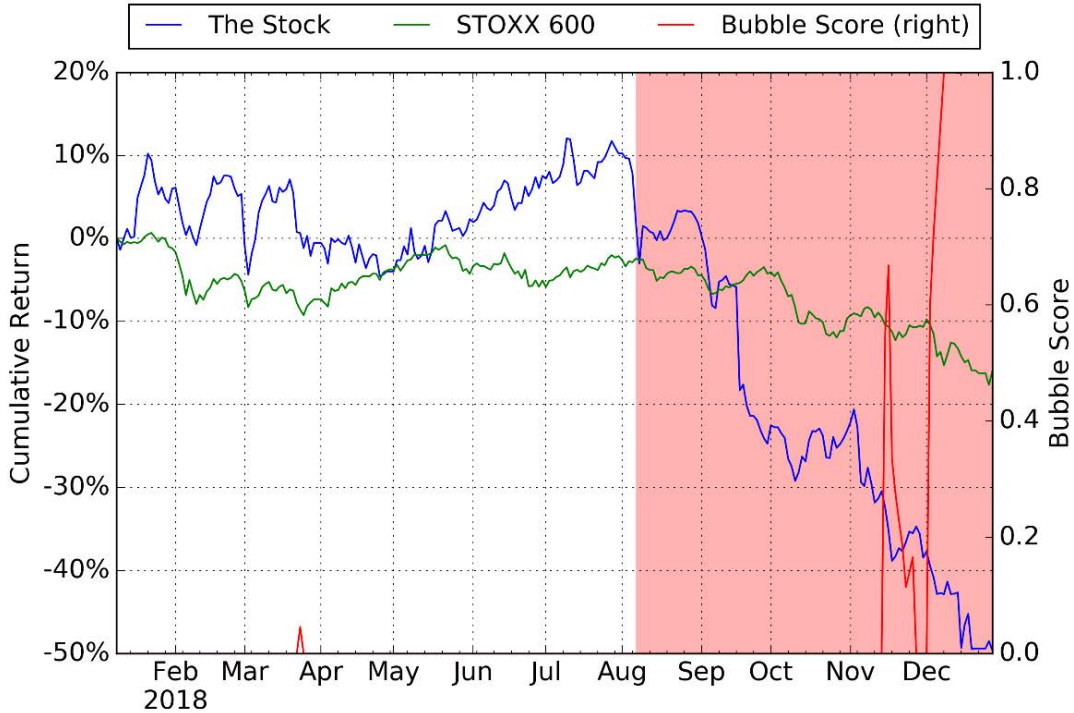
Quadrant 3 stocks: strong negative bubble signals with weak fundamentals (cont'd)

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Fortune Brands Home & Security Inc	United States of America	Capital Goods	-46.1%	-42.0%	Feb-18	-30.8%	30.0%	64.6%
Freeport-McMoRan Inc	United States of America	Materials	-47.3%	-38.0%	Jun-18	-44.4%	19.0%	72.1%
Fleetcor Technologies Inc	United States of America	Software & Services	-9.4%	-17.2%	Aug-18	-91.9%	31.0%	54.3%
Halliburton Co	United States of America	Energy	-50.4%	-36.7%	Jul-18	-100.0%	10.0%	22.0%
Home Depot Inc	United States of America	Retailing	-12.6%	-16.0%	Jul-18	-19.7%	11.3%	52.1%
Hilton Worldwide Holdings Inc	United States of America	Consumer Services	-14.6%	-10.9%	Apr-18	-14.3%	9.3%	35.1%
Harley-Davidson Inc	United States of America	Automobiles & Components	-36.7%	-20.1%	May-18	-10.1%	38.0%	64.0%
Illinois Tool Works Inc	United States of America	Capital Goods	-26.2%	-19.9%	Mar-18	-9.3%	20.1%	77.4%
Leggett & Platt Inc	United States of America	Consumer Durables & Apparel	-26.3%	-15.4%	Apr-18	-1.3%	31.8%	74.0%
Masco Corp	United States of America	Capital Goods	-36.8%	-22.6%	Apr-18	-8.6%	19.1%	77.1%
Northrop Grumman Corp	United States of America	Capital Goods	-21.7%	-24.7%	Jul-18	-91.0%	31.1%	32.4%
ONEOK Inc	United States of America	Energy	-9.2%	-20.6%	May-18	-48.1%	9.6%	51.8%
Occidental Petroleum Corp	United States of America	Energy	-20.2%	-26.6%	May-18	-68.3%	13.5%	81.3%
Pioneer Natural Resources Co	United States of America	Energy	-29.1%	-30.8%	Jul-18	-61.3%	9.8%	18.3%
Raytheon Co	United States of America	Capital Goods	-20.9%	-22.6%	Jul-18	-93.3%	29.5%	65.9%
Schlumberger NV	United States of America	Energy	-52.5%	-46.4%	Jul-18	-62.6%	16.1%	47.1%
Constellation Brands Inc	United States of America	Food, Beverage & Tobacco	-25.7%	-27.7%	Jun-18	-86.2%	19.5%	39.9%
Tiffany & Co	United States of America	Retailing	-26.4%	-41.9%	Jun-18	-71.3%	24.3%	42.3%
Williams Companies Inc	United States of America	Energy	-35.1%	-17.3%	43221	-16.5%	23.2%	97.2%
AAK AB (publ)	Sweden	Food, Beverage & Tobacco	3.0%	-14.7%	43282	-21.2%	24.9%	53.0%
Kindred Group PLC	Malta	Consumer Services	-34.9%	-30.6%	43191	-36.3%	22.4%	3.7%
Atlas Copco AB	Sweden	Capital Goods	-24.0%	-24.0%	43101	-0.6%	24.6%	88.4%
Weir Group PLC	United Kingdom	Capital Goods	-41.4%	-38.0%	43191	-66.1%	28.3%	88.3%

Single Stocks - Quadrant 3 stocks

Quadrant 3 stocks: strong negative bubble signals with weak fundamentals
Example: Zalando SE.

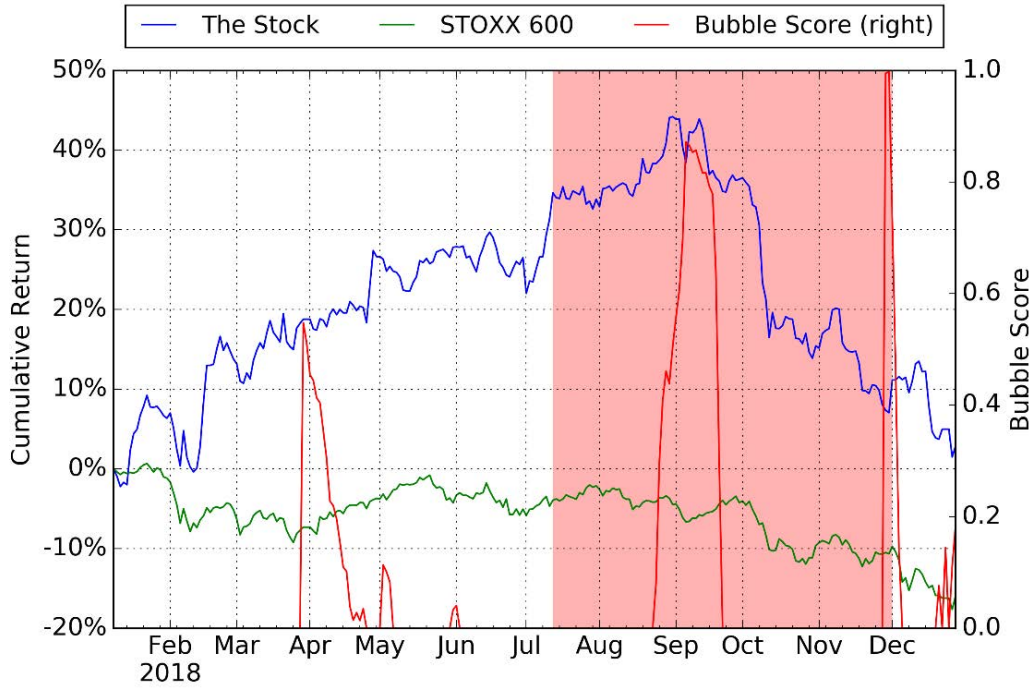


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the negative bubble we identified. The Bubble Score of this five month bubble has reached 100% with a bubble size -50.5%.

Single Stocks - Quadrant 3 stocks

Last month example: strong negative bubble signals with weak fundamentals, Ipsen SA.

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 dropped again after a small rebound at the beginning of December, which is in agreement with the DS LPPLS indicator and the weak fundamentals. The small negative bubble signal identified this month indicates a longer negative bubble may mature.



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
Cognizant Technology Solutions Corp	United States of America	Software & Services	-15.0%	-23.0%	Jul-18	-2.9%	63.9%	42.8%
Kraft Heinz Co	United States of America	Food, Beverage & Tobacco	-43.5%	-30.1%	Aug-18	-66.1%	71.0%	70.7%
Lam Research Corp	United States of America	Semiconductors & Semiconductor Equipment	-28.4%	-39.8%	Mar-18	-22.1%	96.3%	20.7%
Micron Technology Inc	United States of America	Semiconductors & Semiconductor Equipment	-26.3%	-46.5%	May-18	-42.0%	99.6%	7.1%
Mylan NV	United Kingdom	Pharmaceuticals, Biotechnology & Life Sciences	-41.6%	-38.1%	Jan-18	-43.7%	96.6%	20.2%
NetApp Inc	United States of America	Technology Hardware & Equipment	-4.4%	-27.7%	Aug-18	-100.0%	92.6%	52.6%
NXP Semiconductors NV	Netherlands	Semiconductors & Semiconductor Equipment	-39.5%	-41.0%	Mar-18	-3.7%	70.7%	21.1%
Qorvo Inc	United States of America	Semiconductors & Semiconductor Equipment	-11.7%	-25.7%	Jul-18	-92.6%	96.2%	50.7%
Western Digital Corp	United States of America	Technology Hardware & Equipment	-55.3%	-54.4%	Jun-18	-61.0%	98.8%	14.6%
Solvay SA	Belgium	Materials	-26.1%	-24.5%	Apr-18	-51.8%	77.7%	4.0%
BAE Systems PLC	United Kingdom	Capital Goods	-21.1%	-31.3%	Jul-18	-63.3%	79.9%	25.5%
Babcock International Group PLC	United Kingdom	Commercial & Professional Services	-31.0%	-42.0%	Jun-18	-92.5%	92.1%	45.6%
Balfour Beatty PLC	United Kingdom	Capital Goods	-18.3%	-15.1%	Jun-18	-34.4%	76.6%	90.0%
BP PLC	United Kingdom	Energy	-5.7%	-13.7%	Jun-18	-39.7%	84.5%	86.6%
Capita PLC	United Kingdom	Commercial & Professional Services	-55.2%	-27.1%	Jun-18	-45.6%	89.0%	99.0%
Covestro AG	Germany	Materials	-51.2%	-45.5%	Jul-18	-99.5%	96.8%	2.8%
BASF SE	Germany	Materials	-35.7%	-28.4%	Jul-18	-32.2%	63.0%	35.6%
Bayer AG	Germany	Pharmaceuticals, Biotechnology & Life Sciences	-41.7%	-37.1%	Apr-18	-18.0%	89.1%	30.4%
Daimler AG	Germany	Automobiles & Components	-37.6%	-22.9%	Jul-18	-100.0%	86.2%	26.7%
Evonik Industries AG	Germany	Materials	-29.7%	-32.2%	Aug-18	-95.2%	88.5%	18.7%
Fresenius Medical Care AG & Co KGaA	Germany	Health Care Equipment & Services	-37.2%	-34.7%	Jun-18	-26.8%	75.1%	73.7%
freenet AG	Germany	Telecommunication Services	-46.2%	-29.5%	Jul-18	-79.3%	68.7%	92.9%
Fraport AG Frankfurt Airport Services Worldwide	Germany	Transportation	-34.3%	-26.2%	Jun-18	-33.1%	63.7%	76.2%
HeidelbergCement AG	Germany	Materials	-44.1%	-31.2%	Jun-18	-23.8%	67.4%	99.1%
HELLA GmbH & Co KgaA	Germany	Automobiles & Components	-38.4%	-29.6%	Jul-18	-32.9%	87.2%	89.4%
Deutsche Lufthansa AG	Germany	Transportation	-35.6%	-25.5%	Feb-18	-4.6%	99.1%	0.5%
Aurubis AG	Germany	Materials	-47.5%	-41.9%	Apr-18	-51.1%	95.5%	53.4%
RTL Group SA	Luxembourg	Media & Entertainment	-32.3%	-32.7%	Feb-18	-36.0%	61.8%	48.4%
K&S AG	Germany	Materials	-27.2%	-33.8%	Mar-18	-11.5%	72.3%	2.1%
Siemens AG	Germany	Capital Goods	-19.3%	-12.8%	Aug-18	-28.5%	72.0%	95.6%
Software AG	Germany	Software & Services	-34.5%	-23.7%	Jun-18	-42.2%	74.3%	79.1%

Single Stocks - Quadrant 4 stocks

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Quadrant 4 stocks: strong negative bubble signals with strong fundamentals (cont'd)

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Pandora A/S	Denmark	Consumer Durables & Apparel	-55.4%	-47.0%	May-18	-73.1%	95.9%	94.1%
Daily Mail and General Trust P L C	United Kingdom	Media & Entertainment	-1.3%	-20.7%	Jun-18	-27.0%	81.8%	8.3%
Repsol SA	Spain	Energy	-5.4%	-14.2%	Aug-18	-69.6%	97.4%	3.0%
Atos SE	France	Software & Services	-43.5%	-36.9%	May-18	-21.1%	85.0%	21.6%
Faurecia SA	France	Automobiles & Components	-55.2%	-48.1%	Jul-18	-56.3%	80.9%	87.7%
Capgemini SE	France	Software & Services	-18.4%	-24.5%	Apr-18	-41.9%	87.8%	9.5%
Bouygues SA	France	Capital Goods	-30.6%	-25.6%	Feb-18	-16.4%	81.0%	1.7%
Eiffage SA	France	Capital Goods	-22.4%	-24.5%	Jul-18	-49.1%	69.9%	13.8%
Orpea SA	France	Health Care Equipment & Services	-12.7%	-29.6%	Jul-18	-82.0%	90.6%	54.1%
Schneider Electric SE	France	Capital Goods	-19.5%	-20.0%	Apr-18	-21.1%	68.3%	7.0%
Renault SA	France	Automobiles & Components	-38.4%	-45.1%	Mar-18	-59.2%	84.8%	0.1%
Compagnie de Saint Gobain SA	France	Capital Goods	-39.2%	-28.6%	Jun-18	-20.6%	85.1%	23.9%
Spie SA	France	Commercial & Professional Services	-47.5%	-35.6%	Jul-18	-84.4%	69.3%	1.2%
GVC Holdings PLC	Isle of Man	Consumer Services	-28.7%	-38.1%	Jul-18	-80.6%	66.2%	98.3%
ASM International NV	Netherlands	Semiconductors & Semiconductor Equipment	-39.3%	-36.8%	Feb-18	-10.1%	96.7%	8.8%
ArcelorMittal SA	Luxembourg	Materials	-40.4%	-36.1%	Aug-18	-98.8%	90.2%	0.2%
Koninklijke Philips NV	Netherlands	Health Care Equipment & Services	-7.4%	-13.1%	Apr-18	-28.5%	85.7%	14.3%
Randstad NV	Netherlands	Commercial & Professional Services	-30.1%	-26.7%	May-18	-27.4%	77.8%	13.9%
Hays PLC	United Kingdom	Commercial & Professional Services	-28.2%	-23.8%	May-18	-39.8%	76.7%	29.0%
CNH Industrial NV	United Kingdom	Capital Goods	-34.7%	-34.7%	Jan-18	-42.6%	74.6%	80.6%
Leonardo SpA	Italy	Capital Goods	-29.4%	-25.1%	Jul-18	-63.6%	83.4%	96.5%
ITV PLC	United Kingdom	Media & Entertainment	-25.6%	-27.4%	May-18	-18.4%	89.3%	11.7%
Stora Enso Oyj	Finland	Materials	-26.2%	-43.5%	Jun-18	-37.7%	69.6%	6.6%
Meggitt PLC	United Kingdom	Capital Goods	-3.0%	-17.2%	Jul-18	-44.0%	84.9%	36.1%
Norsk Hydro ASA	Norway	Materials	-37.0%	-17.1%	Aug-18	-13.3%	80.6%	15.4%
Subsea 7 SA	United Kingdom	Energy	-35.6%	-33.5%	Jun-18	-91.2%	99.4%	75.4%
Andritz AG	Austria	Capital Goods	-15.9%	-20.9%	Aug-18	-18.8%	82.9%	96.6%
voestalpine AG	Austria	Materials	-51.4%	-40.0%	Jul-18	-36.5%	76.3%	2.7%
Wienerberger AG	Austria	Materials	-14.4%	-23.3%	May-18	-62.2%	63.3%	12.3%
Persimmon PLC	United Kingdom	Consumer Durables & Apparel	-26.8%	-26.2%	Apr-18	-49.2%	96.5%	51.1%
Ryanair Holdings PLC	Ireland; Republic of	Transportation	-32.5%	-34.5%	Mar-18	-55.4%	87.6%	87.3%

Single Stocks - Quadrant 4 stocks

Entrepreneurial Risks
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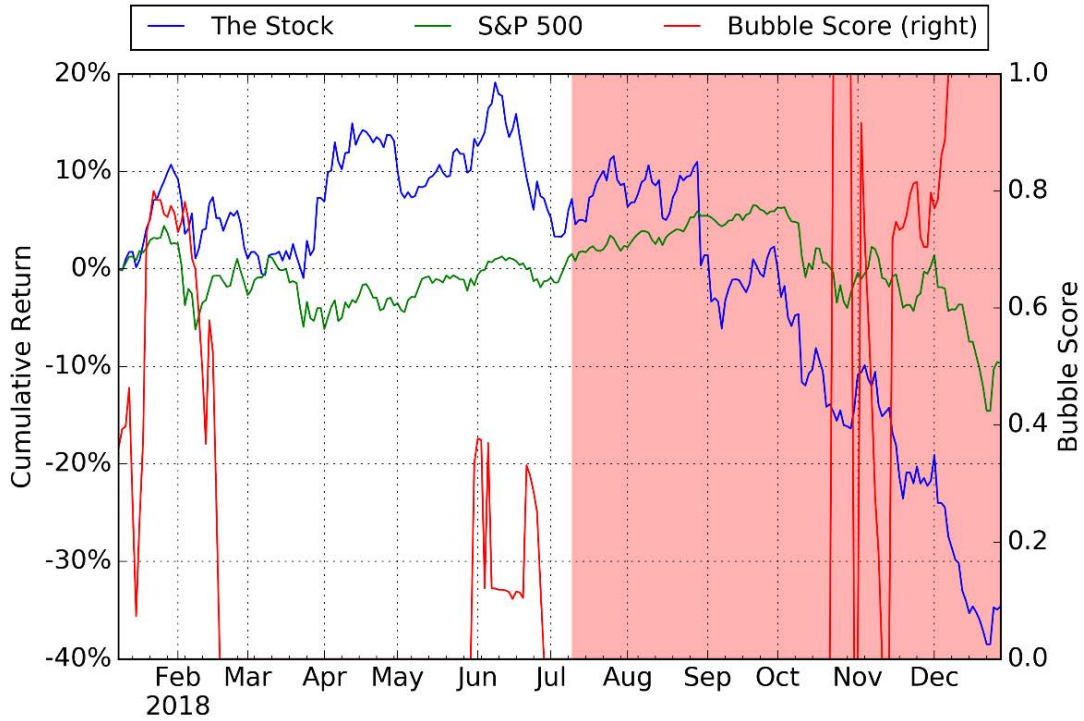
Quadrant 4 stocks: strong negative bubble signals with strong fundamentals (cont'd)

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
Compagnie Financiere Richemont SA	Switzerland	Consumer Durables & Apparel	-29.7%	-26.5%	Jul-18	-49.7%	70.5%	97.9%
Dufry AG	Switzerland	Retailing	-36.9%	-23.7%	Aug-18	-15.2%	65.5%	97.7%
The Swatch Group AG	Switzerland	Consumer Durables & Apparel	-29.7%	-41.8%	Jun-18	-24.3%	63.4%	89.6%
SSE PLC	United Kingdom	Utilities	-19.5%	-22.9%	May-18	-8.4%	62.1%	13.2%
Tesco PLC	United Kingdom	Food & Staples Retailing	-5.0%	-24.6%	Jun-18	-72.0%	84.0%	92.3%
Tui AG	Germany	Consumer Services	-28.8%	-32.2%	Jun-18	-84.2%	76.0%	49.9%
Taylor Wimpey PLC	United Kingdom	Consumer Durables & Apparel	-30.3%	-21.9%	Jul-18	-52.8%	95.0%	22.8%
Alliance Data Systems Corp	United States of America	Software & Services	-45.2%	-35.8%	Jun-18	-71.6%	62.8%	41.1%
Arconic Inc	United States of America	Capital Goods	-44.9%	-21.6%	Jul-18	-29.2%	69.8%	84.0%
Baxter International Inc	United States of America	Health Care Equipment & Services	-4.7%	-13.4%	Jun-18	-3.4%	65.0%	36.0%
Best Buy Co Inc	United States of America	Retailing	-28.4%	-32.8%	Aug-18	-99.3%	80.0%	6.5%
BorgWarner Inc	United States of America	Automobiles & Components	-38.3%	-32.3%	May-18	-17.0%	70.4%	31.6%
Celanese Corp	United States of America	Materials	-19.6%	-21.5%	May-18	-18.7%	73.8%	46.0%
Coty Inc	United States of America	Household & Personal Products	-68.4%	-54.2%	Jul-18	-85.1%	64.4%	43.8%
Quest Diagnostics Inc	United States of America	Health Care Equipment & Services	-18.8%	-22.2%	Jul-18	-82.4%	83.9%	55.1%
Eastman Chemical Co	United States of America	Materials	-25.8%	-32.0%	Jun-18	-15.9%	65.9%	10.2%
Fluor Corp	United States of America	Capital Goods	-43.3%	-43.5%	Aug-18	-89.1%	71.1%	31.3%
Hess Corp	United States of America	Energy	-26.2%	-37.1%	Jul-18	-63.2%	72.4%	72.2%
International Business Machines Corp	United States of America	Software & Services	-31.2%	-24.0%	Apr-18	-14.3%	74.9%	58.5%
Kinder Morgan Inc	United States of America	Energy	-20.4%	-14.8%	Aug-18	-62.2%	78.4%	49.0%
LyondellBasell Industries NV	United States of America	Materials	-30.0%	-28.6%	May-18	-2.9%	97.9%	38.0%
Noble Energy Inc	United States of America	Energy	-42.7%	-45.2%	Apr-18	-77.7%	61.3%	0.7%
National Oilwell Varco Inc	United States of America	Energy	-33.7%	-46.4%	Jul-18	-32.7%	91.3%	33.4%
PVH Corp	United States of America	Consumer Durables & Apparel	-35.2%	-39.0%	Jul-18	-100.0%	81.5%	39.1%
AT&T Inc	United States of America	Telecommunication Services	-22.0%	-22.0%	Jan-18	-43.7%	78.9%	17.6%
Tapestry Inc	United States of America	Consumer Durables & Apparel	-25.7%	-29.6%	Jul-18	-97.9%	62.6%	43.7%
Tyson Foods Inc	United States of America	Food, Beverage & Tobacco	-34.5%	-31.2%	Jan-18	-19.7%	81.2%	22.7%
Westrock Co	United States of America	Materials	-45.4%	-45.3%	43101	-5.1%	66.0%	32.0%
Boliden AB	Sweden	Materials	-34.5%	-36.6%	43191	-4.8%	80.5%	3.5%
Dometic Group AB (publ)	Sweden	Automobiles & Components	-39.0%	-40.2%	43252	-10.7%	79.1%	2.4%
Trelleborg AB	Sweden	Capital Goods	-30.3%	-24.8%	43313	-40.9%	72.7%	86.0%

Single Stocks - Quadrant 4 stocks

Quadrant 4 stocks: strong negative bubble signals with strong fundamentals

Example: PVH Corp.

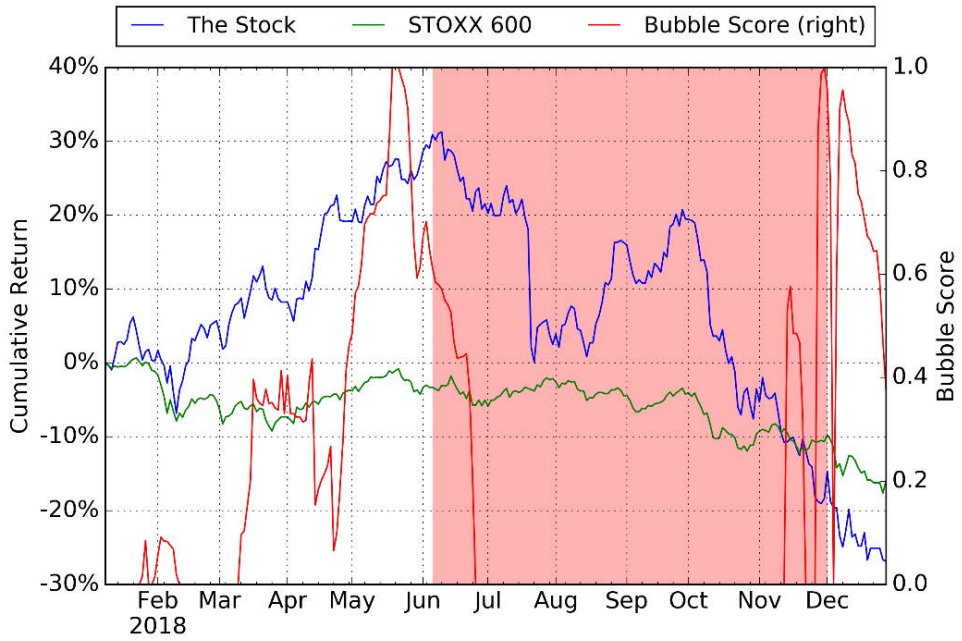


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this seven month bubble has reached 100% with a bubble size -39%. 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, Stora Enso Oyj.

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



Sectors

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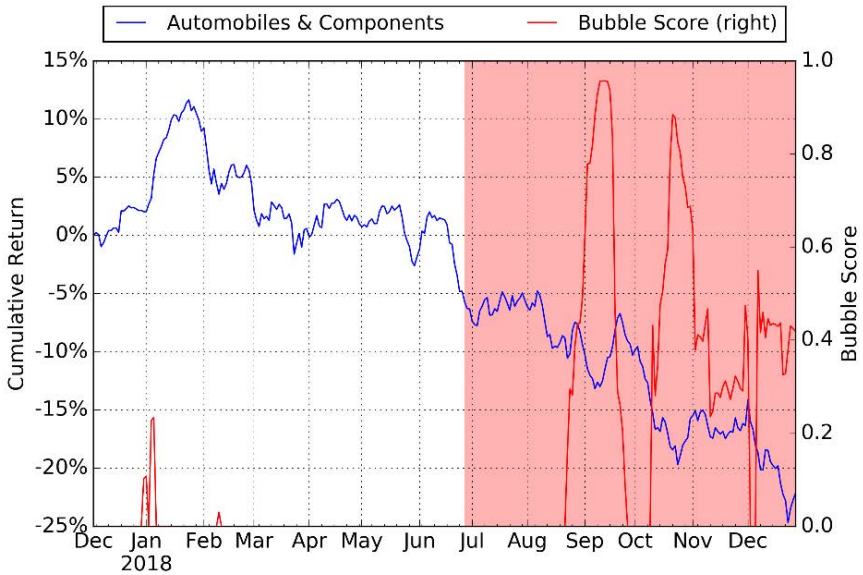
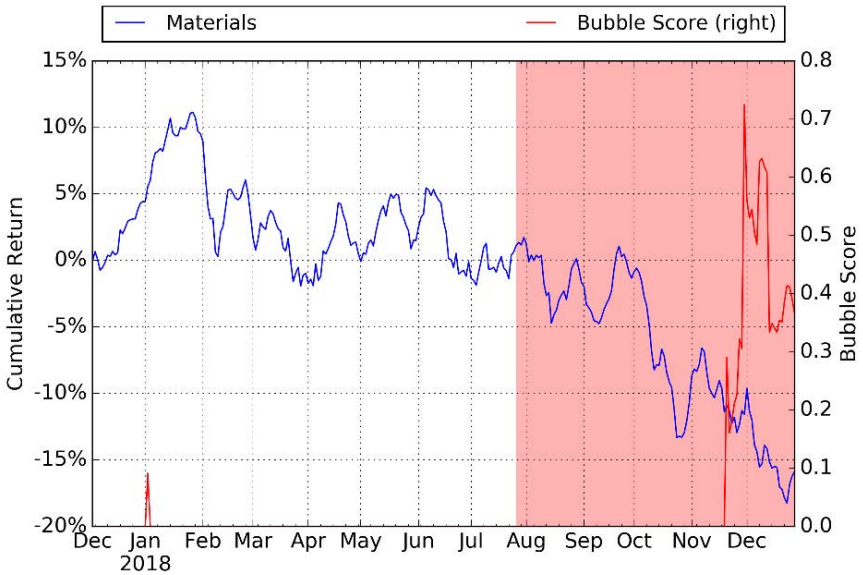
GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	Jan 1st	Dec 1st	Jan 1st	Dec 1st	Jan 1st	Dec 1st	Jan 1st	Dec 1st	Jan 1st	Dec 1st
Pharmaceuticals, Biotechnology & Life Sciences	-4.6%	7.4%	0.0%	0.0%	0.0%	0.0%	63.9%	63.6%	57.8%	57.4%
Consumer Services	-11.2%	-1.5%	0.0%	0.0%	0.0%	0.0%	30.6%	29.7%	49.4%	48.8%
Retailing	0.1%	19.1%	-15.9%	0.0%	-50.7%	0.0%	19.2%	19.4%	59.5%	57.8%
Transportation	-16.4%	-0.6%	0.0%	0.0%	0.0%	0.0%	56.5%	57.0%	55.7%	56.3%
Consumer Durables & Apparel	-15.3%	-7.0%	-18.1%	0.0%	-40.5%	0.0%	36.9%	37.0%	57.5%	54.5%
Semiconductors & Semiconductor Equipment	-17.3%	-5.6%	0.0%	0.0%	0.0%	0.0%	56.8%	58.4%	28.8%	28.8%
Technology Hardware & Equipment	-11.6%	2.9%	0.0%	0.0%	0.0%	0.0%	73.4%	72.1%	40.3%	41.4%
Automobiles & Components	-28.2%	-16.9%	-17.4%	-18.5%	-41.9%	-47.5%	75.8%	77.4%	48.7%	49.5%
Telecommunication Services	-12.6%	-6.3%	0.0%	0.0%	0.0%	0.0%	62.3%	63.8%	39.6%	39.4%
Energy	-22.4%	-5.4%	-22.5%	0.0%	-69.4%	0.0%	51.5%	51.4%	54.9%	51.6%
Software & Services	-4.5%	9.2%	0.0%	0.0%	0.0%	0.0%	38.8%	39.2%	46.5%	45.5%
Materials	-22.8%	-11.9%	-16.8%	-12.2%	-36.6%	-72.5%	53.1%	53.4%	42.1%	41.8%
Health Care Equipment & Services	-0.3%	16.5%	0.0%	0.0%	0.0%	0.0%	66.5%	66.1%	58.6%	59.1%
Capital Goods	-22.8%	-9.2%	-15.1%	0.0%	-50.5%	0.0%	47.8%	47.1%	53.1%	53.6%
Media & Entertainment	-8.2%	3.3%	0.0%	0.0%	0.0%	0.0%	27.0%	28.0%	51.5%	51.5%
Commercial & Professional Services	-8.5%	2.1%	0.0%	0.0%	0.0%	0.0%	34.0%	33.9%	48.6%	49.4%
Food & Staples Retailing	-4.8%	7.2%	0.0%	0.0%	0.0%	0.0%	54.1%	55.1%	63.0%	63.7%
Household & Personal Products	-3.6%	0.1%	0.0%	0.0%	0.0%	0.0%	36.9%	37.3%	51.8%	53.1%
Food, Beverage & Tobacco	-17.8%	-10.0%	0.0%	0.0%	0.0%	0.0%	44.5%	44.8%	57.4%	57.6%
Utilities	0.7%	-0.7%	0.0%	0.0%	0.0%	0.0%	52.0%	51.8%	46.8%	46.4%
Insurance	-16.3%	-6.2%	-14.2%	0.0%	-51.4%	0.0%	-	-	-	-
Real Estate	-7.4%	-3.5%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Diversified Financials	-20.5%	-7.3%	-15.3%	0.0%	-39.8%	0.0%	-	-	-	-
Banks	-26.1%	-11.7%	-17.5%	0.0%	-19.4%	0.0%	-	-	-	-

Sectors

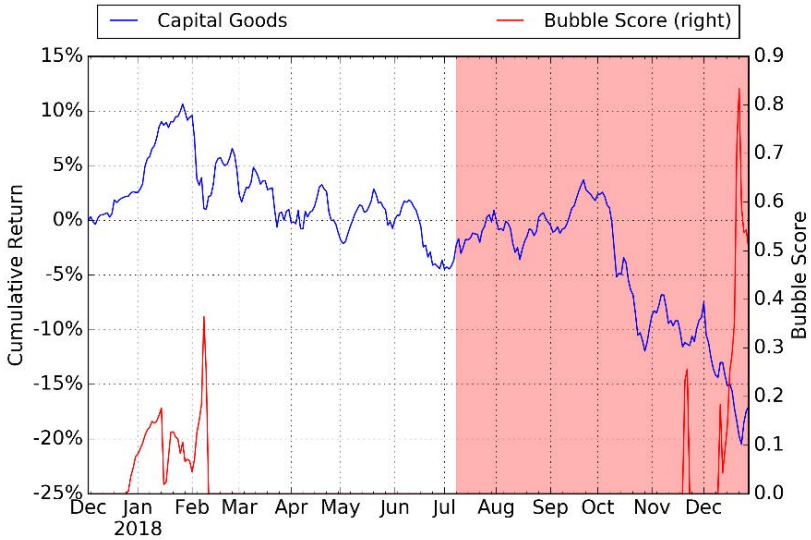
Since Dec 2017, we are using the MSCI World Industry Group Indices to calculate bubble size and bubble score of the corresponding sectors. To determine the value scores and growth scores of the sectors, we average over the corresponding values for each stock of a given sector, weighted by market cap.

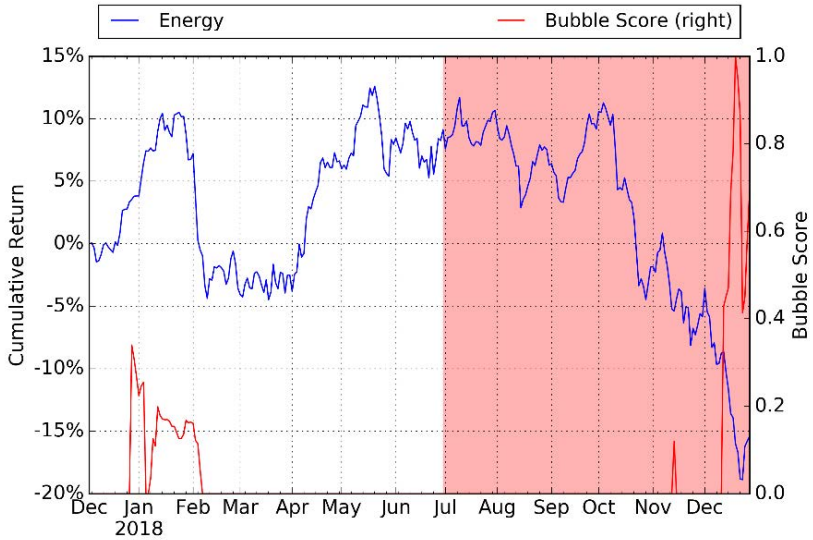
This month, we find 9 industry groups with a negative bubble score: *Automobiles & Components, Banks, Consumer Durables & Apparel, Capital Goods, Diversified Financials, Energy, Insurance, Retailing,* and *Materials*, as shown in the figure below and next two slides. The negative bubble we identified last month in *Automobiles & Components* and *Materials* continued to develop.

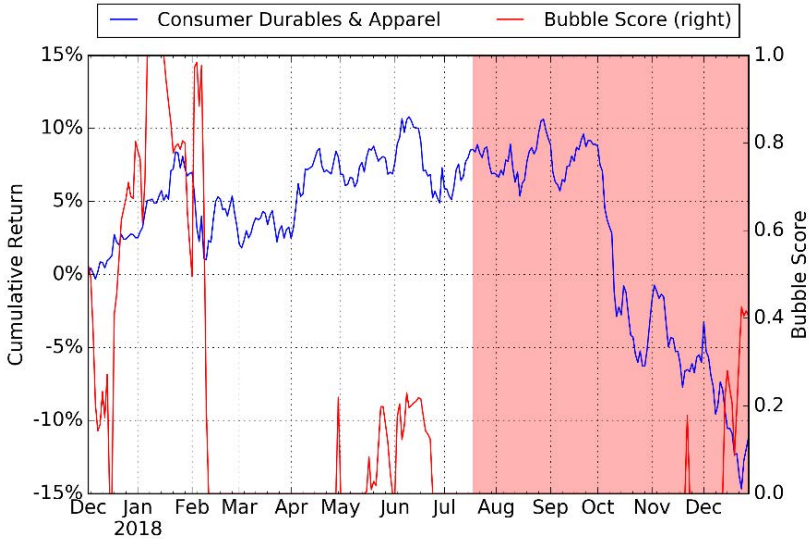


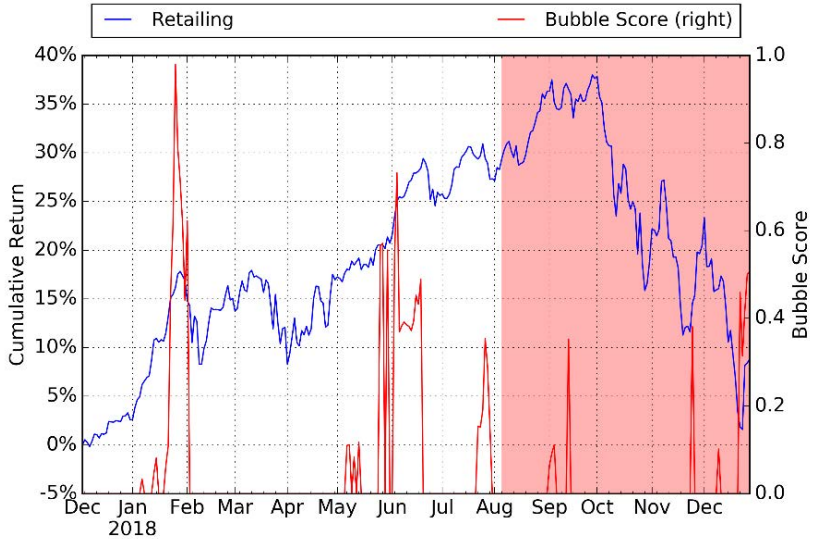


Sectors

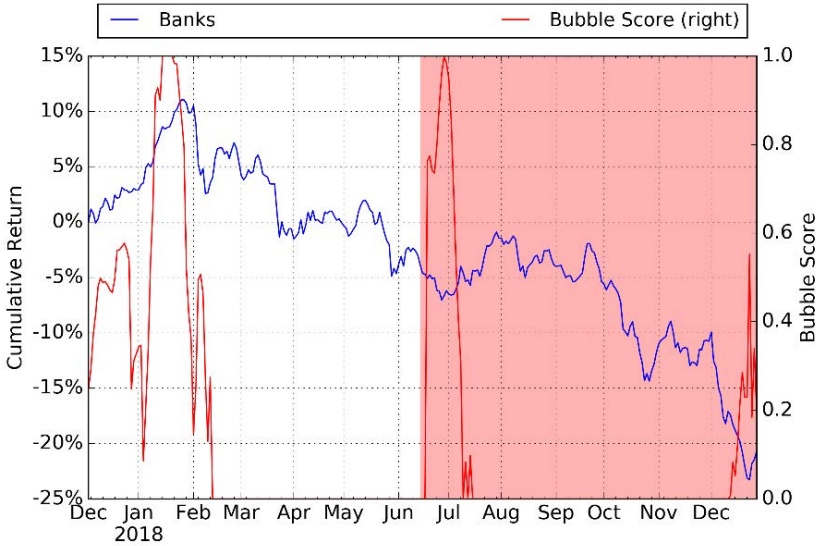

Capital Goods
Bubble Score (right)
Cumulative Return
Bubble Score
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2018


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


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


Retailing
Bubble Score (right)
Cumulative Return
Bubble Score
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
1.0
0.8
0.6
0.4
0.2
0.0
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2018

Sectors


Banks
Bubble Score (right)
Cumulative Return
Bubble Score
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
1.0
0.8
0.6
0.4
0.2
0.0
Dec
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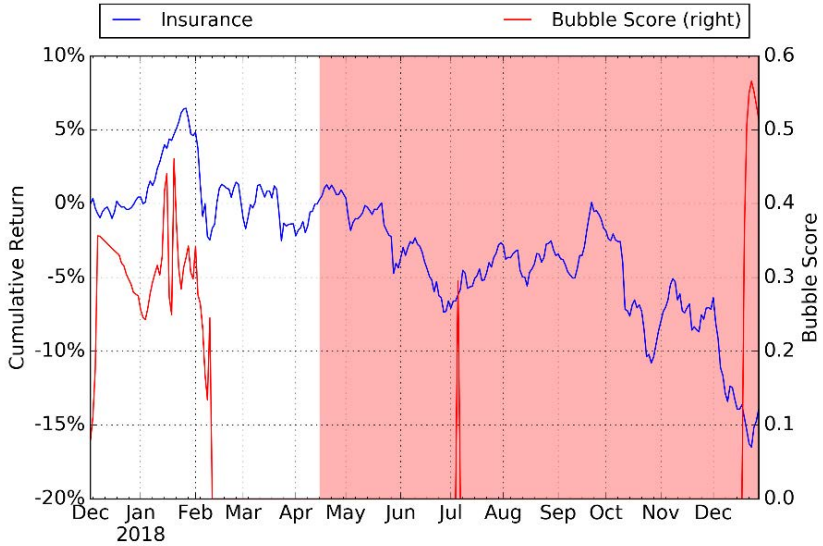
Dec


Insurance
Bubble Score (right)
Cumulative Return
Bubble Score
10%
5%
0%
-5%
-10%
-15%
-20%
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Dec
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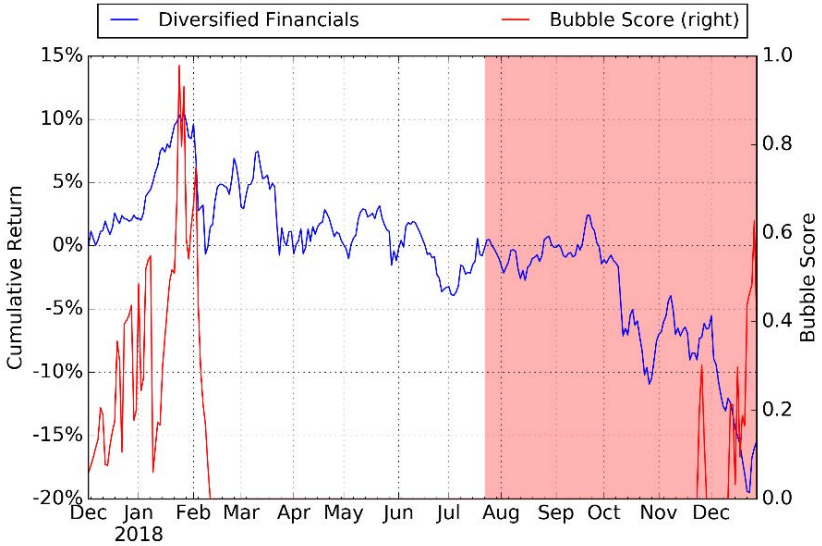
Dec


Diversified Financials
Bubble Score (right)
Cumulative Return
Bubble Score
15%
10%
5%
0%
-5%
-10%
-15%
-20%
1.0
0.8
0.6
0.4
0.2
0.0
Dec
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Oct
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Dec

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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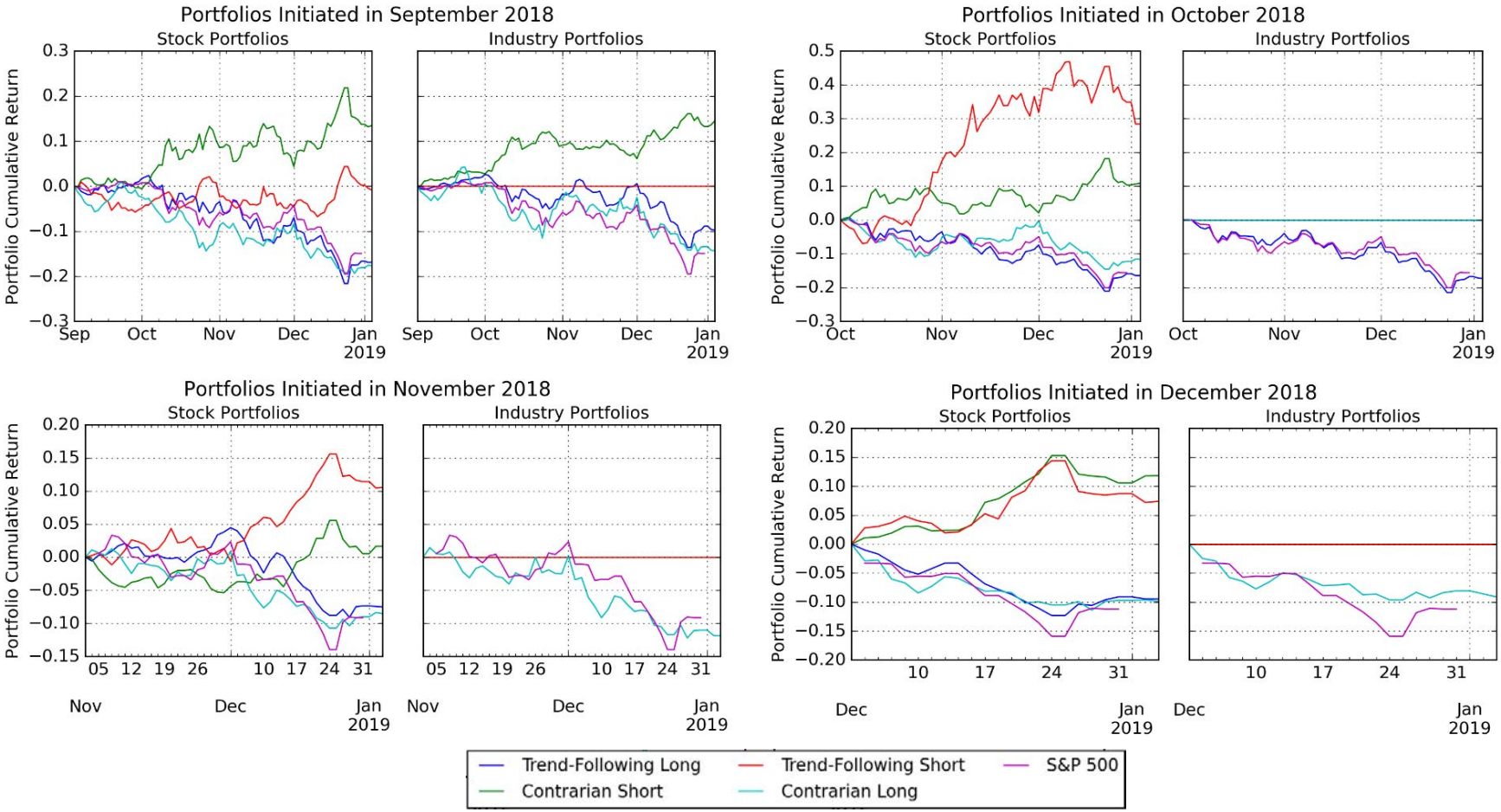
At the same time, we also classified 20 industries into 4 quadrants, and constructed 4 type of industry portfolios based on the 4 industry quadrants. Each portfolio consists of all the stocks in the industries listed in the corresponding quadrant. Following the same definitions as above, we have Trend-Following 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 Short Portfolios initiated in September, October, November and December 2018 outperformed the others, due to the recent market corrections. 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.

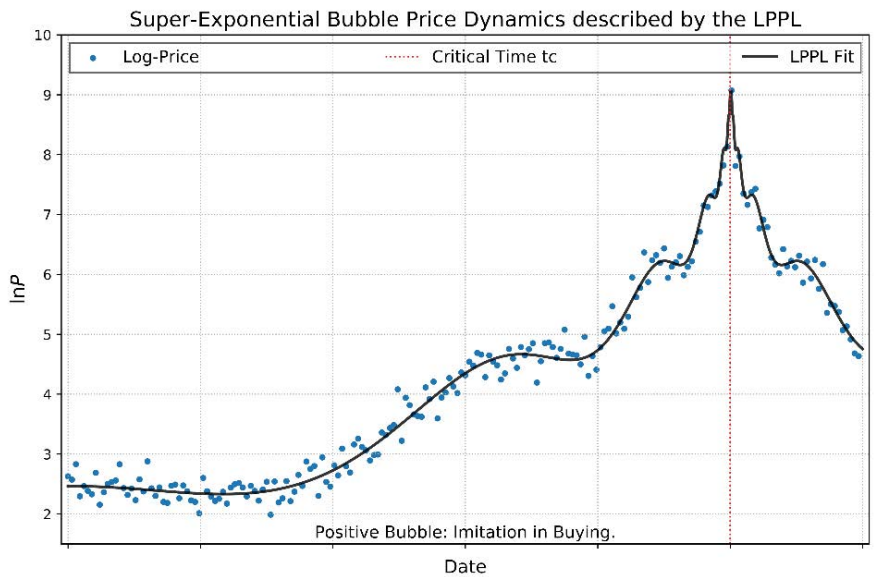
Appendix

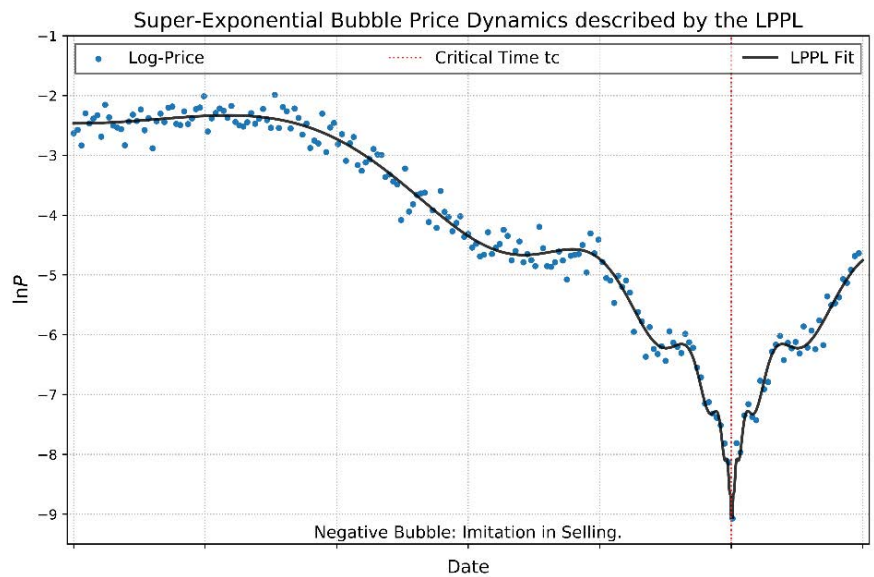
Methodology

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:

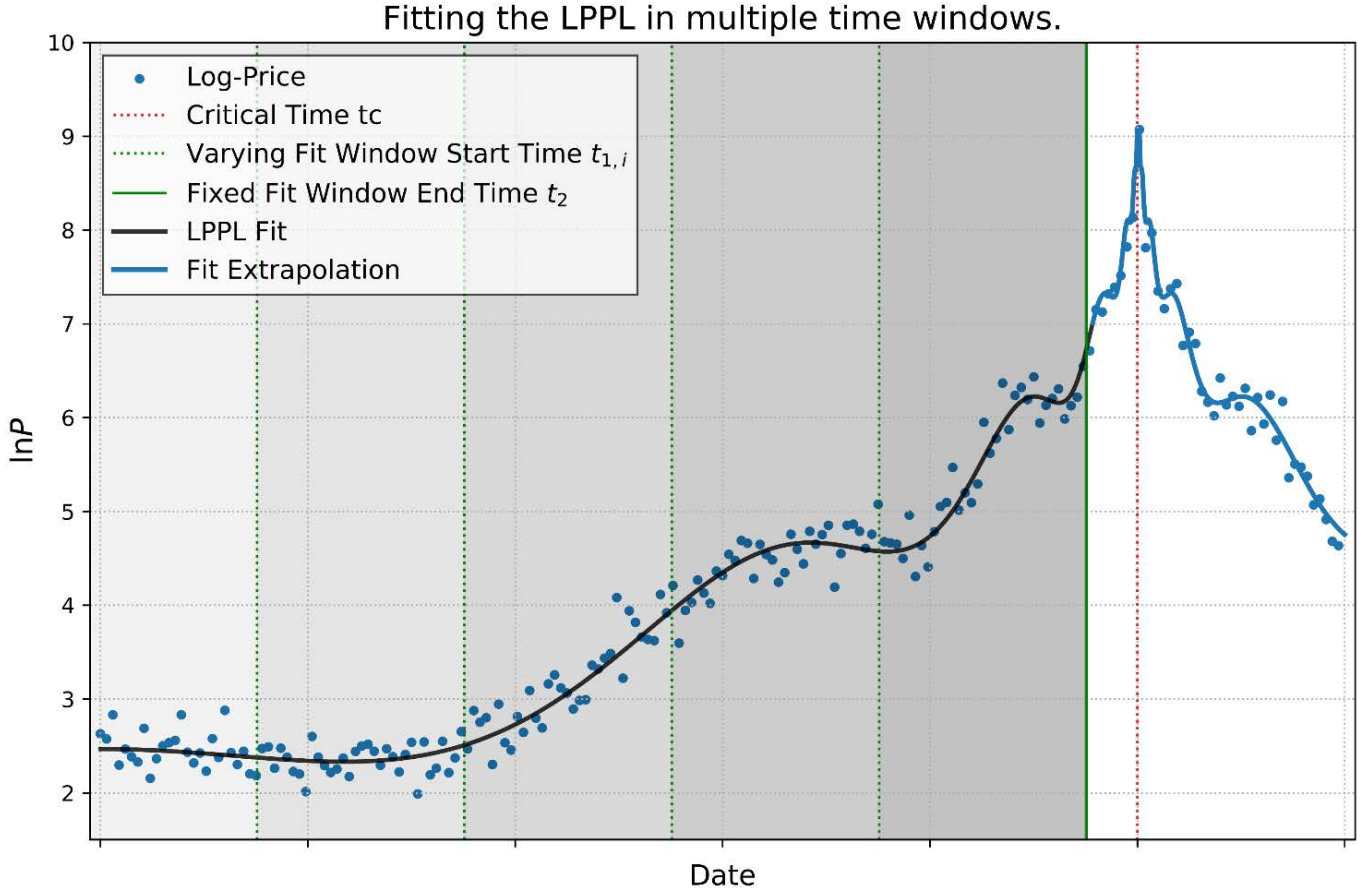
$$LPPLS := E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$

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

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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.

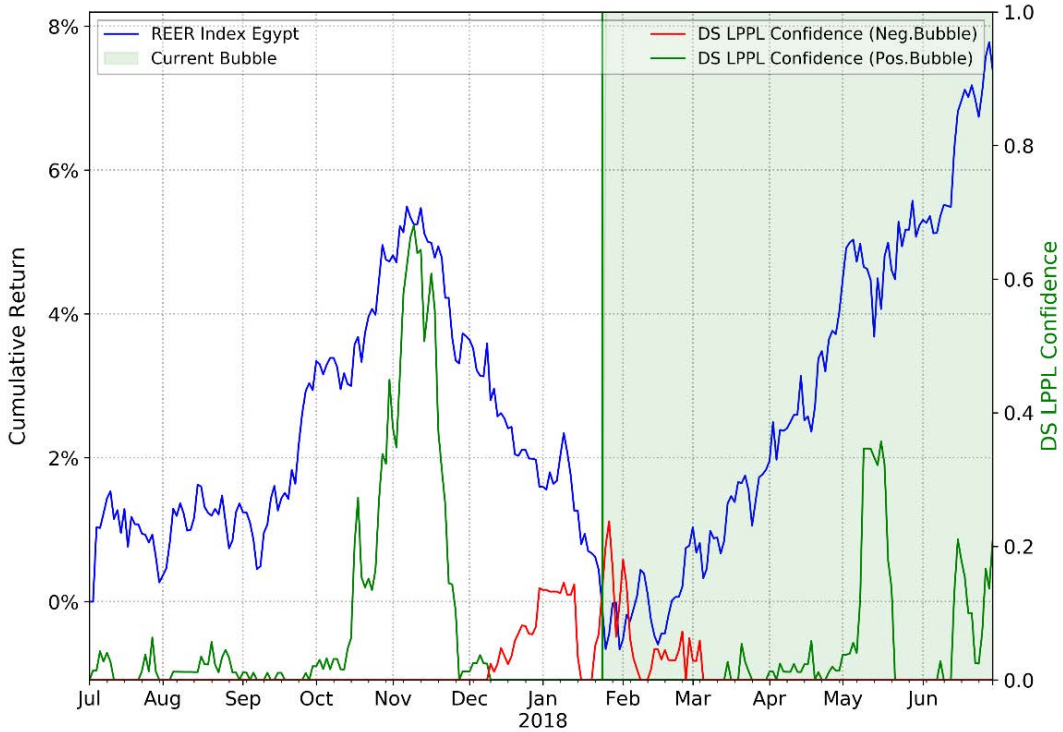
The first section provides asset and estimated bubble characteristics (size and duration), as well as the value of the confidence indicator. We rank assets according to their geometric average of the absolute of bubble size and confidence indicator. In this way, we incorporate the bubble size into the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

Visit the Financial Crisis Observatory for more information

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