The FCO Cockpit
Global Bubble Status Report

Jan-Christian Gerlach, Didier Sornette & Ke Wu

Chair of Entrepreneurial Risks
Department of Management, Technology and Economics
ETH Zurich
Scheuchzerstrasse 7
8092 Zurich, Switzerland

March 1st , 2019

Contents

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.

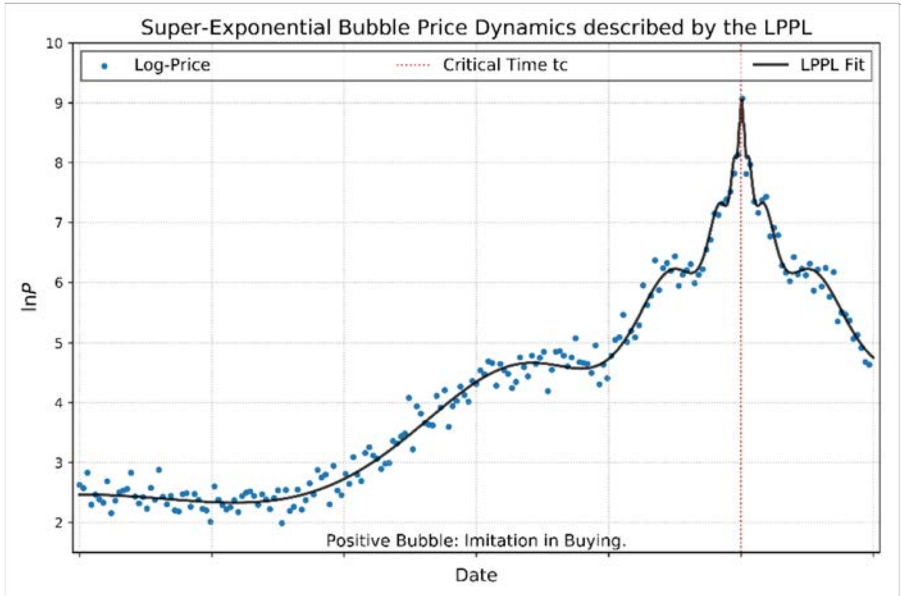
For an intuitive explanation of the methodology and the specifics of the indicators that are used in this report, we refer to: D. Sornette and P. Cauwels, Financial bubbles: mechanisms and diagnostics. Review of Behavioral Economics 2 (3), 279- 305 (2015)
http://arxiv.org/abs/1404.2140 and http://ssrn.com/abstract=2423790

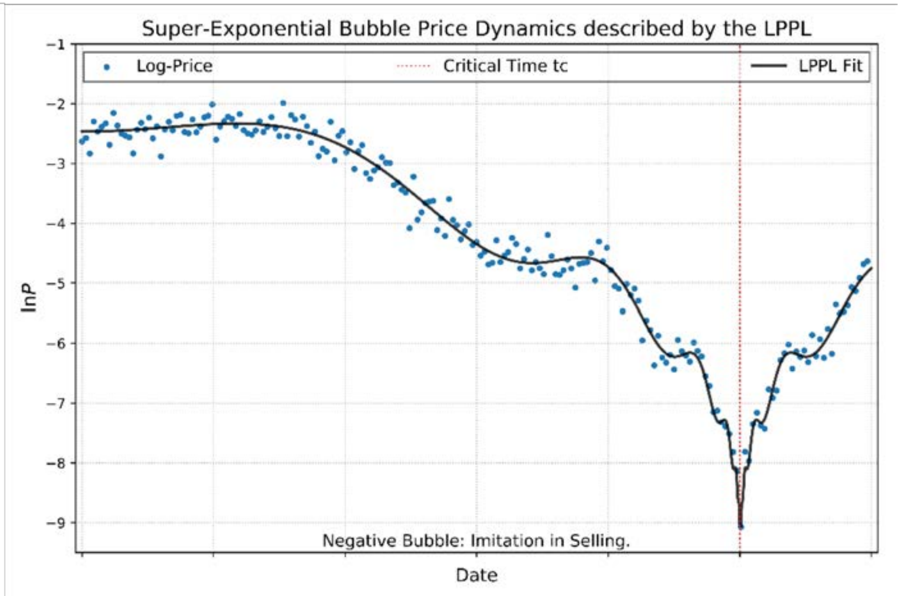
Methodology

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:

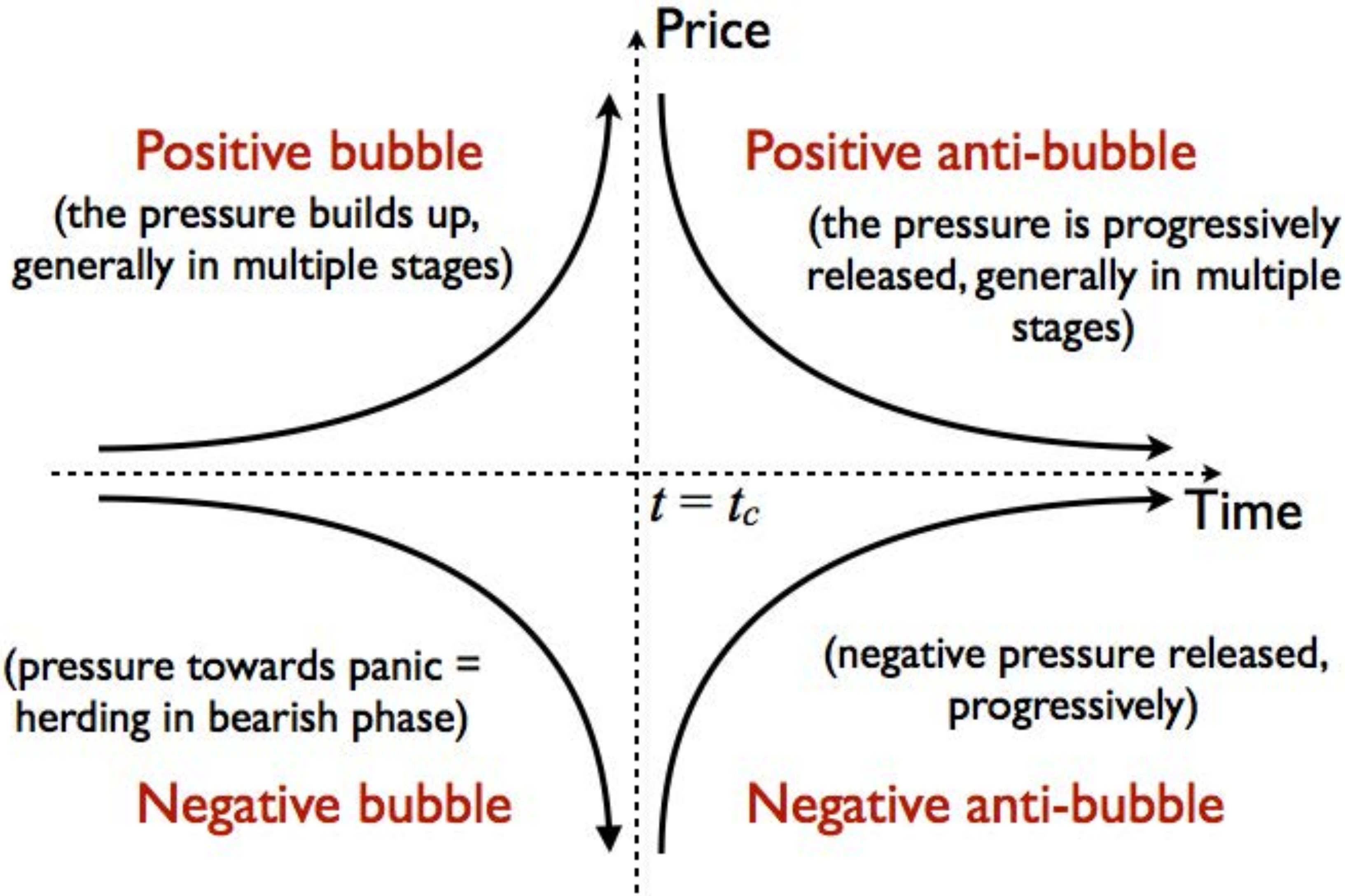
1. During the growth phase of a positive (negative) bubble, the price rises (falls) faster than exponentially. Therefore the logarithm of the price rises faster than linearly.
2. There are accelerating log-periodic oscillations around the super-exponential price evolution that symbolize increases in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



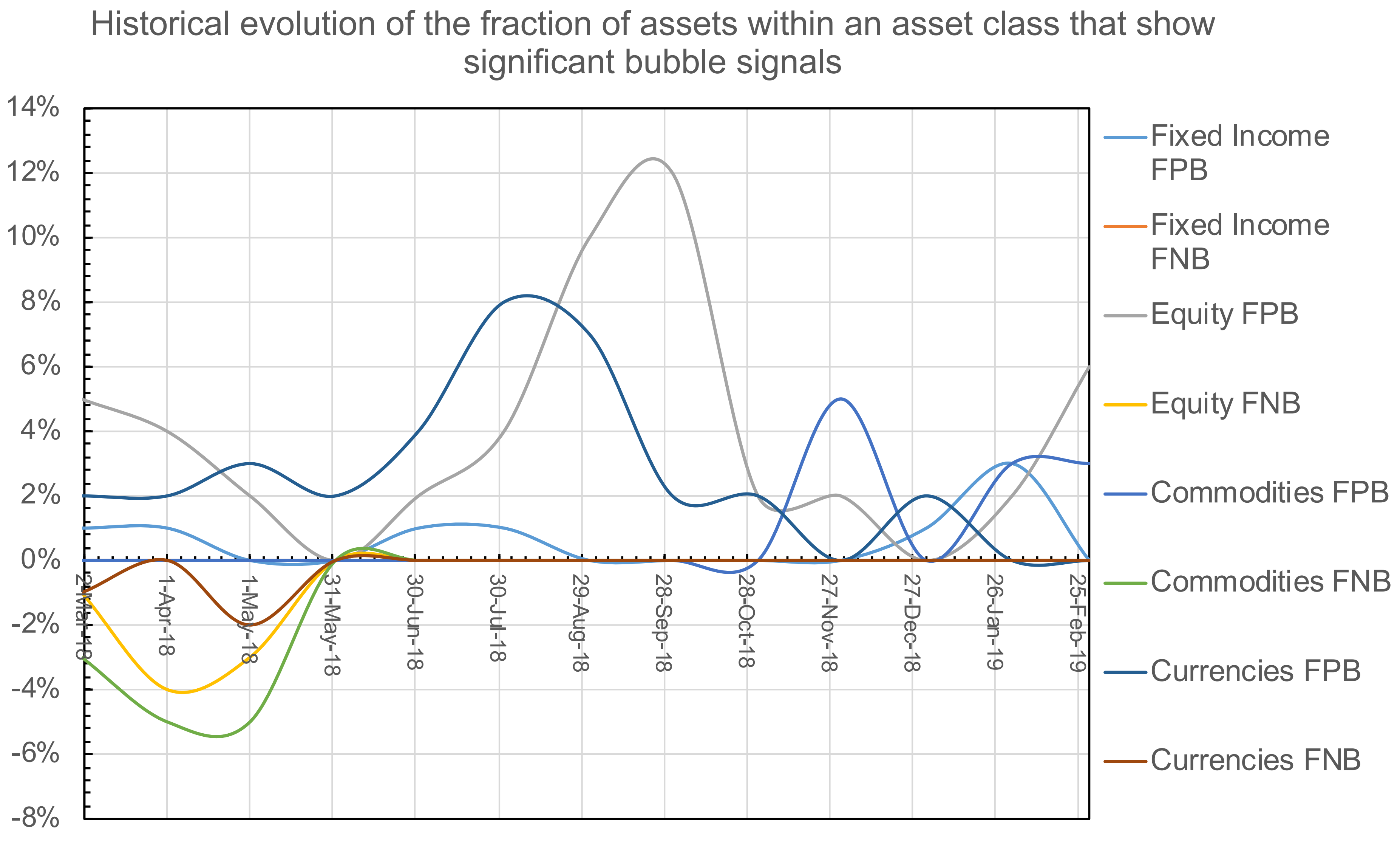


Bubble Regimes



General Results – The Big Picture

Entrepreneurial Risks
ETH zürich



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

General Results – This Month's Overview

Entrepreneurial Risks ETH zürich

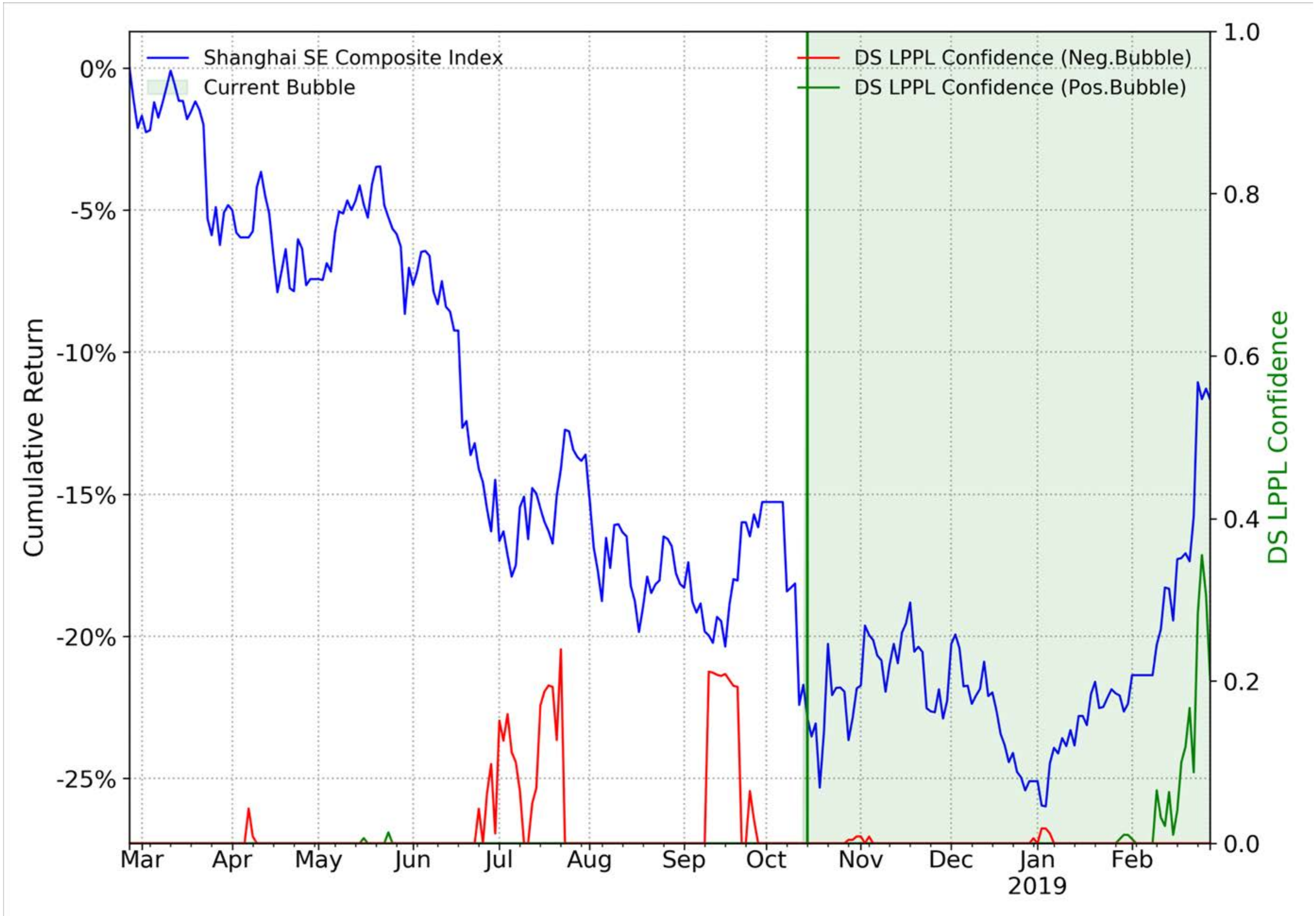
Category		Analyzed Assets	Fraction of Pos. Bubbles [%]	Fraction of Neg. Bubbles [%]
Fixed Income		155	0	0
	Government Bonds	55	0	0
	Finance and Insurance	21	0	0
	Corporate Bonds	79	0	0
Equity		306	6	0
	Country Indices	66	6	0
	Europe	36	0	0
	United States	204	6	0
Commodities		36	3	0
Forex		54	0	0

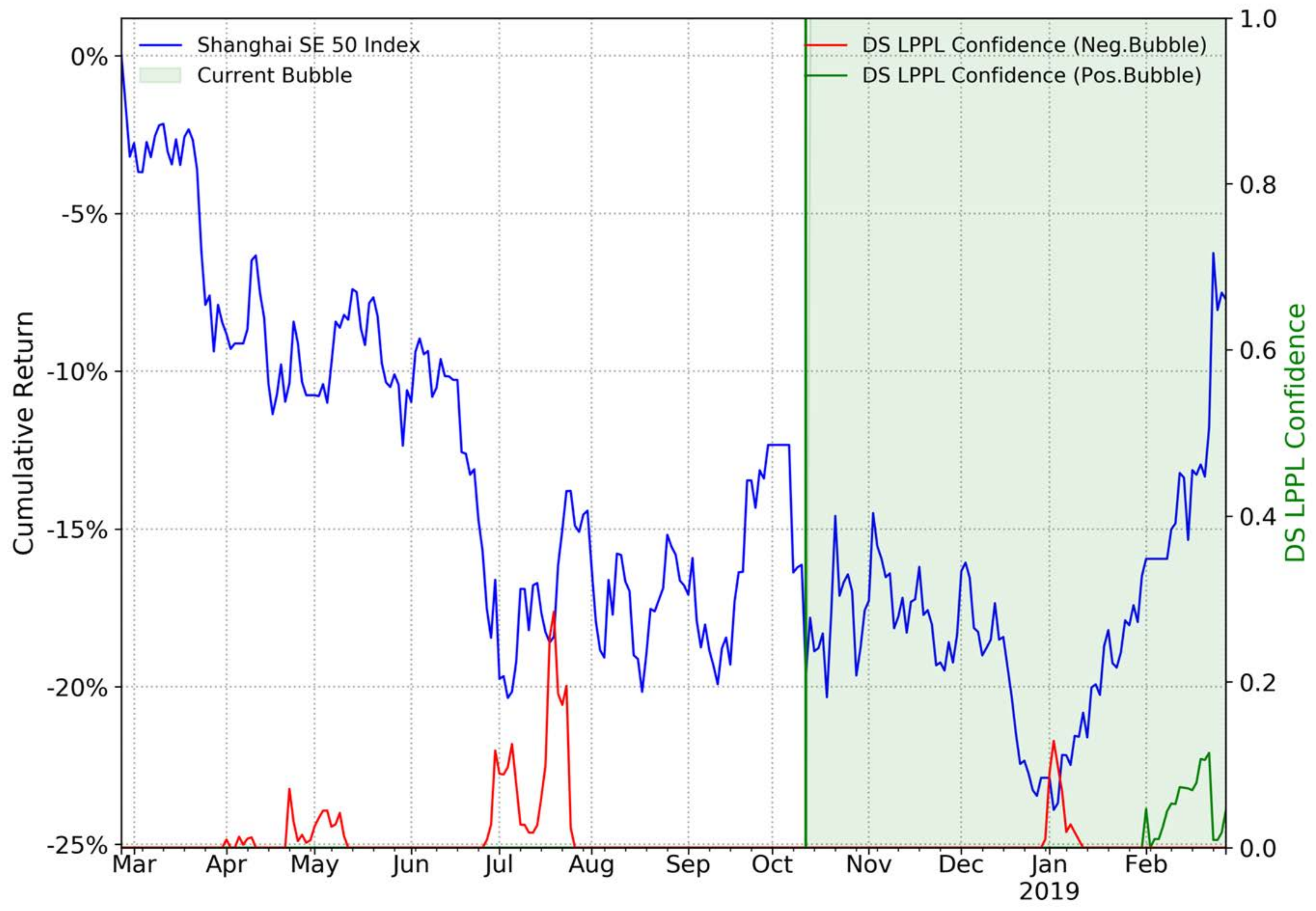
Throughout February, similarly as in January, bubble activity has remained at a low level, despite the recent appreciation of asset prices in many sectors. We however find that the price increase has put some of the analyzed assets into a positive bubble state. In the following, we discuss the few bubble signals in the Equity and Commodities sectors, as well as for Cryptocurrencies and evaluate some of the previous report's predictions.

Equities – Country Indices

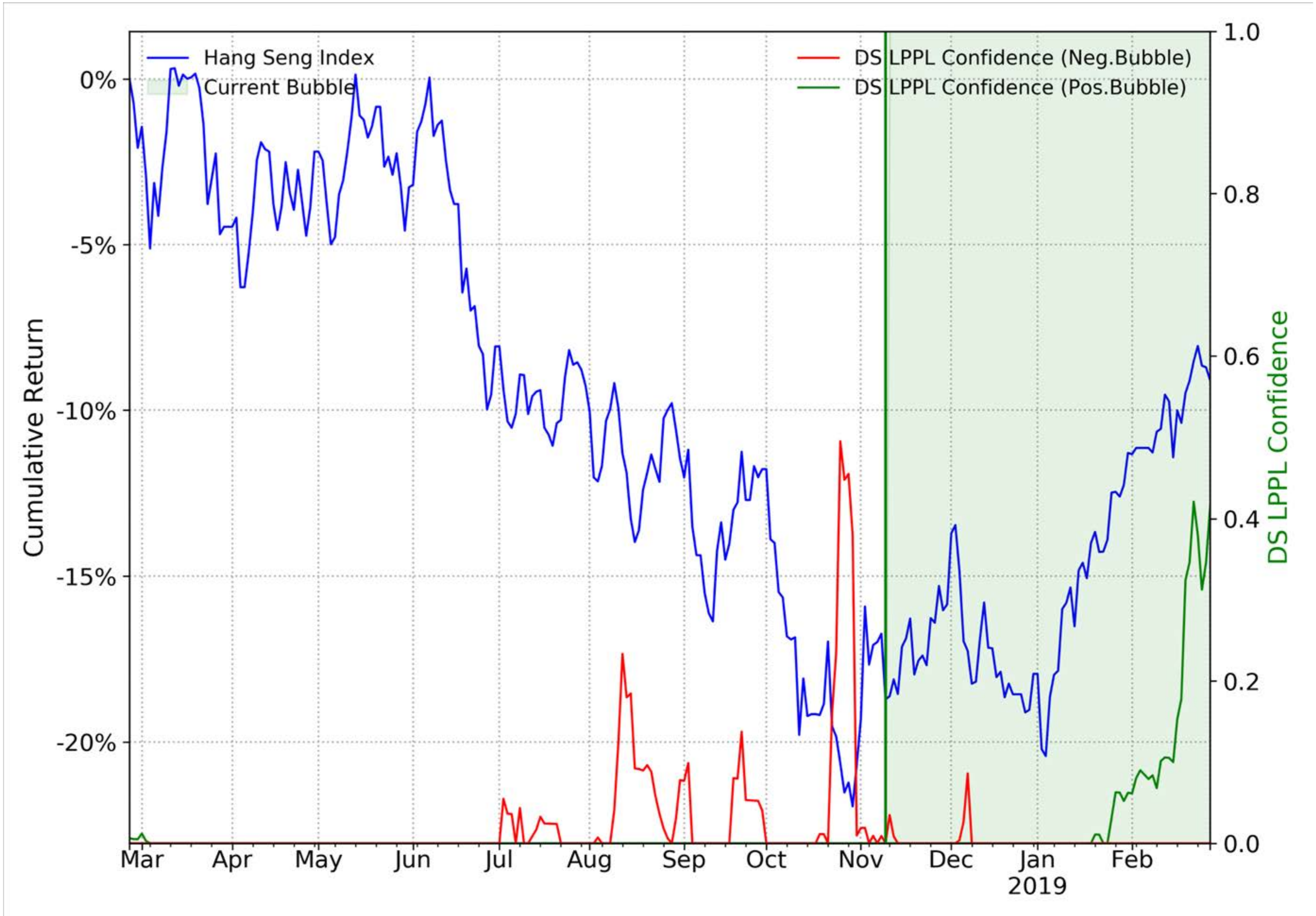
	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration [$days$]	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} [$days$]	Scenario Probability [%]
Positive Bubbles								
1	Shanghai SE Composite Index	15	138	38	24	2019-06-13	20	53
2	Shanghai SE 50 Index	15	140	19	17	2019-06-16	19	58
3	Hang Seng Index	12	111	24	17	2019-03-05	3	83
4	Budapest SE Index	13	236	14	14	2019-03-13	10	70

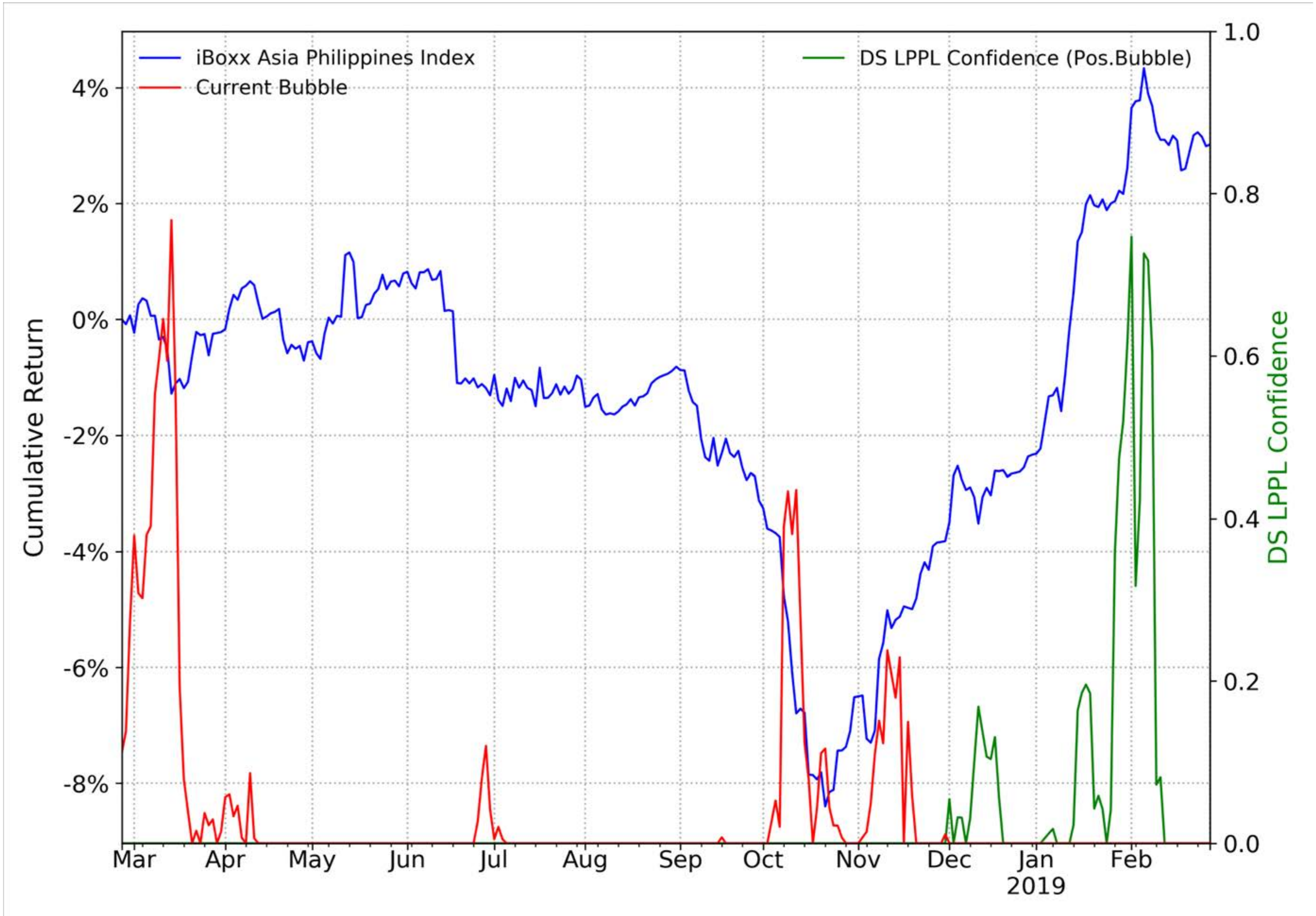
Amongst the analyzed Equity stock indices, this month we find the Shanghai Index at the top of our positive bubbles list twice, followed by another Asian Index, the Hang Seng of Hong Kong. Detected bubble sizes range in 12-15% and the confidence indicator in 19-38%. The predicted critical times for the Shanghai Indices are both located in mid June 2019, suggesting that the forming positive bubble might still grow for some time. The corresponding indicator plots are shown on the following slides. Also shown are the Philippine and Brazil Indices which were highlighted in the previous report.


Shanghai SE Composite Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
0%
-5%
-10%
-15%
-20%
-25%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb

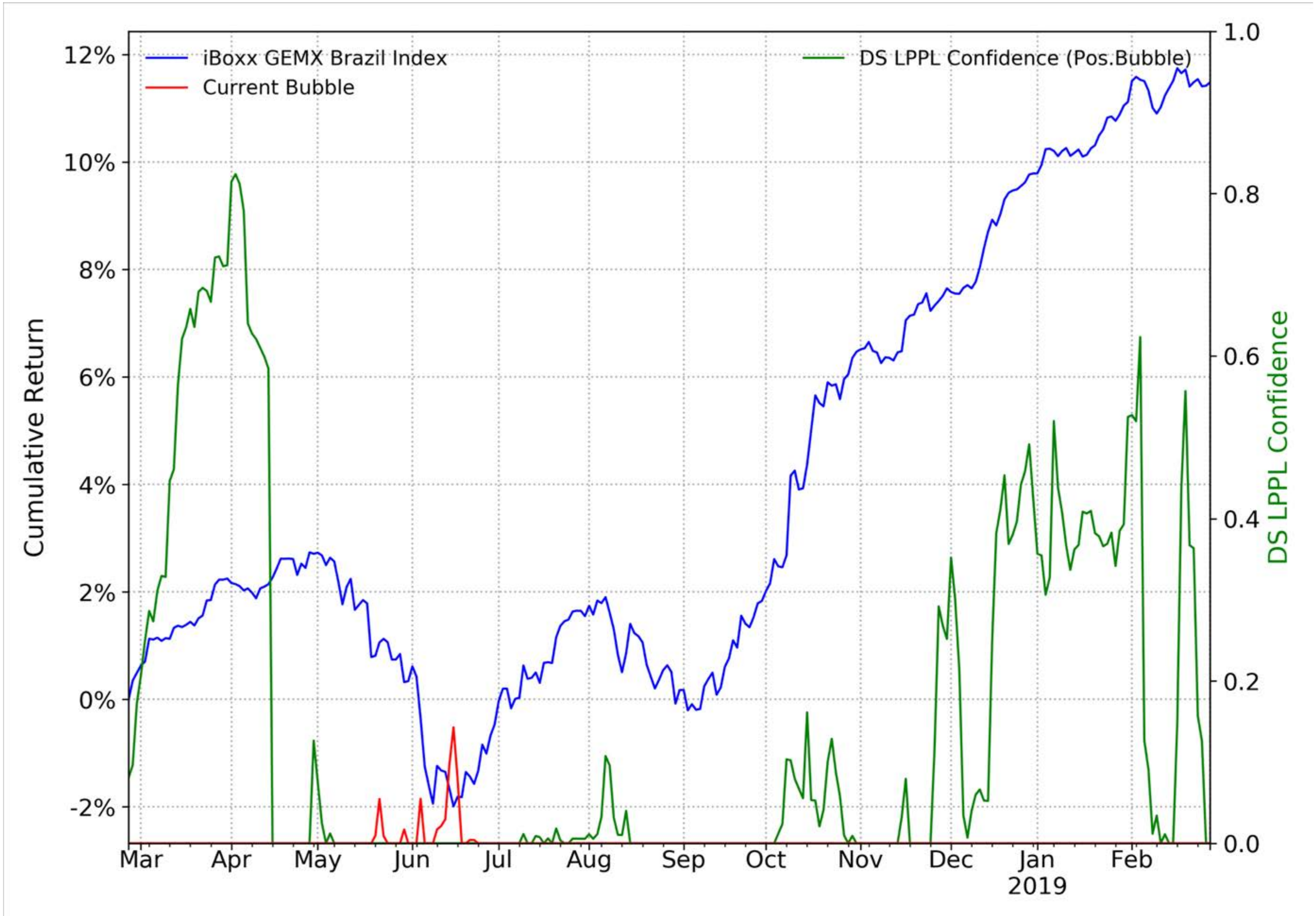


Shanghai SE 50 Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
0%
-5%
-10%
-15%
-20%
-25%
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb
1.0
0.8
0.6
0.4
0.2
0.0
DS LPPL Confidence


Hang Seng Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
0%
-5%
-10%
-15%
-20%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb



iBoxx Asia Philippines Index
Current Bubble
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
4%
2%
0%
-2%
-4%
-6%
-8%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb



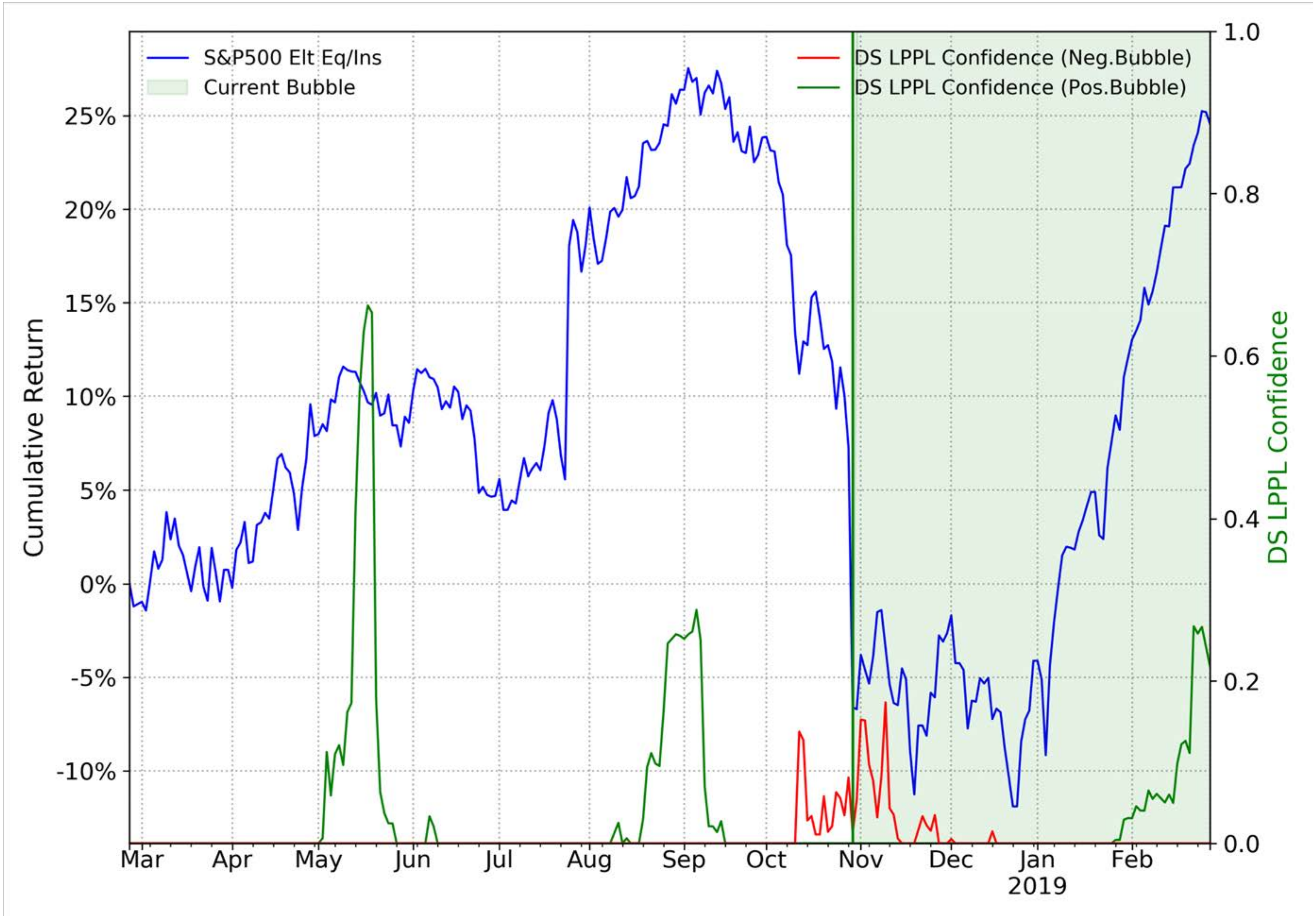
iBoxx GEMX Brazil Index
Current Bubble
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
12%
10%
8%
6%
4%
2%
0%
-2%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb

Equities – United States Indices

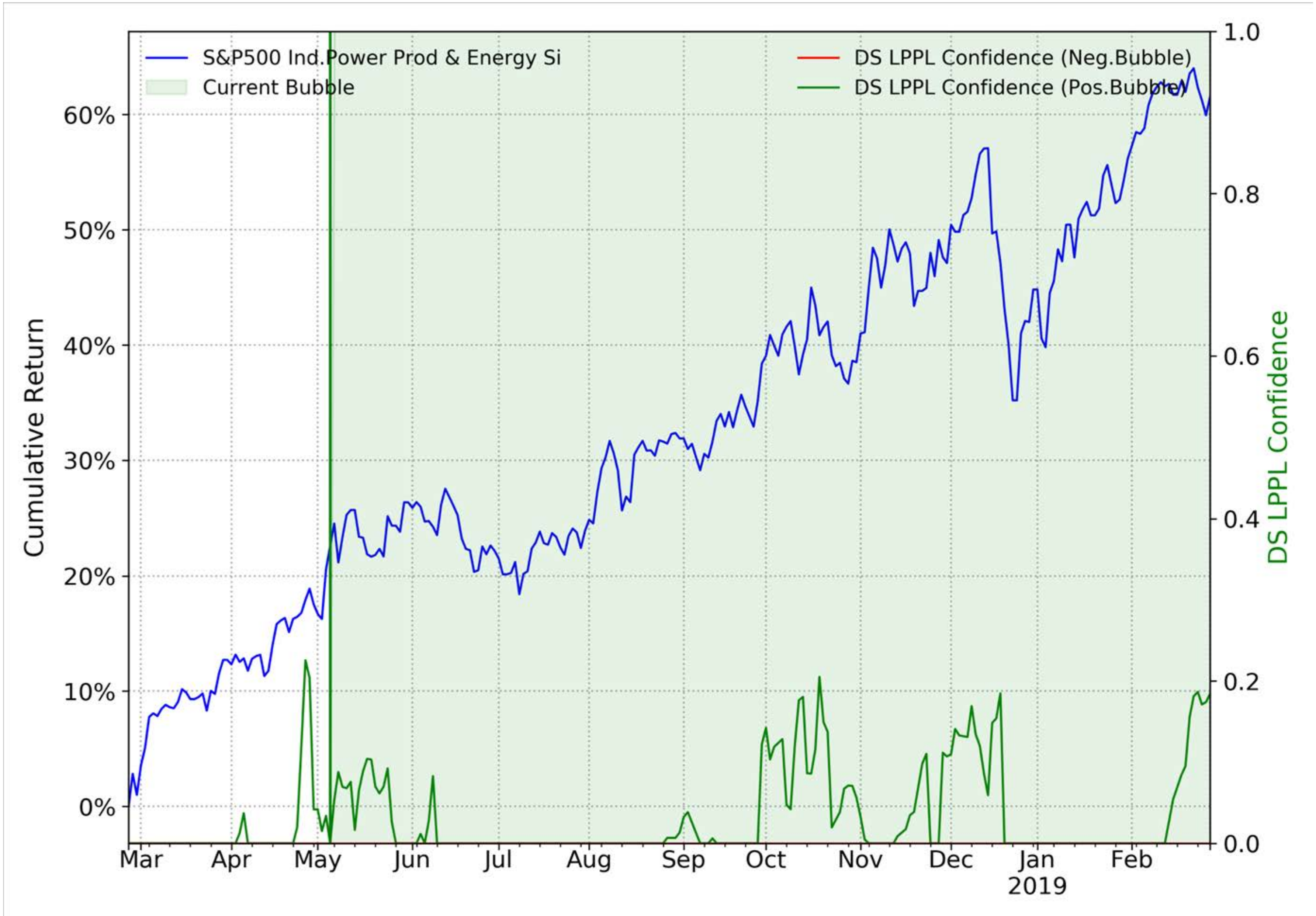
Entrepreneurial Risks
ETH zürich

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration $[days]$	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} $[days]$	Scenario Probability [%]
Positive Bubbles								
1	S&P500 Elt Eq/Ins	33	121	31	32	2019-03-03	4	53
2	S&P500 Ind.Power Prod & Energy Si	32	300	28	30	2019-03-25	16	80
3	S&P500 Ind Pwr&Ren Elec Pr	32	300	28	30	2019-03-25	16	80
4	S&P500 Consumer Electronics	44	343	19	29	2019-03-26	24	75
5	S&P500 Trading Comp & Distributors	17	131	27	21	2019-02-28	1	44

We find a number of US Equity Indices in positive bubble state at the beginning of March 2019. This accompanies the recently seen growth in global financial markets. The complete S&P500 has increased in value by more than 10% year-to-date. For the first listed index, as visible on the next slide, we see remarkable growth of more than 25% over the same time period. LPPLS Confidence Indicator values are at moderate sizes, ranging in 19-31%, while the bubble sizes are quite advanced, at up to 44%.



S&P500 Elt Eq/Ins
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
25%
20%
15%
10%
5%
0%
-5%
-10%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb

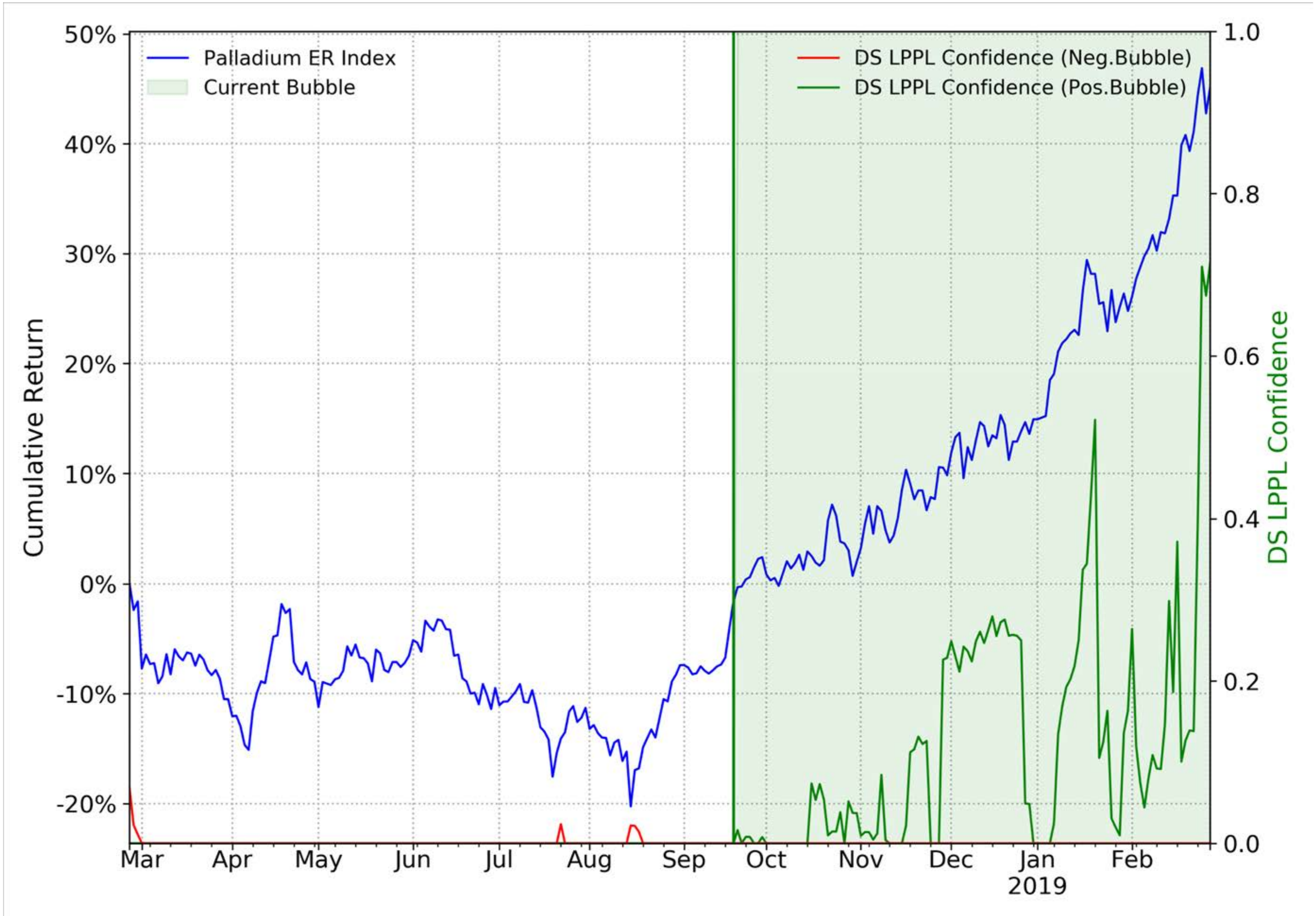


S&P500 Ind.Power Prod & Energy Si
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
60%
50%
40%
30%
20%
10%
0%
1.0
0.8
0.6
0.4
0.2
0.0
DS LPPL Confidence
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb

Commodities

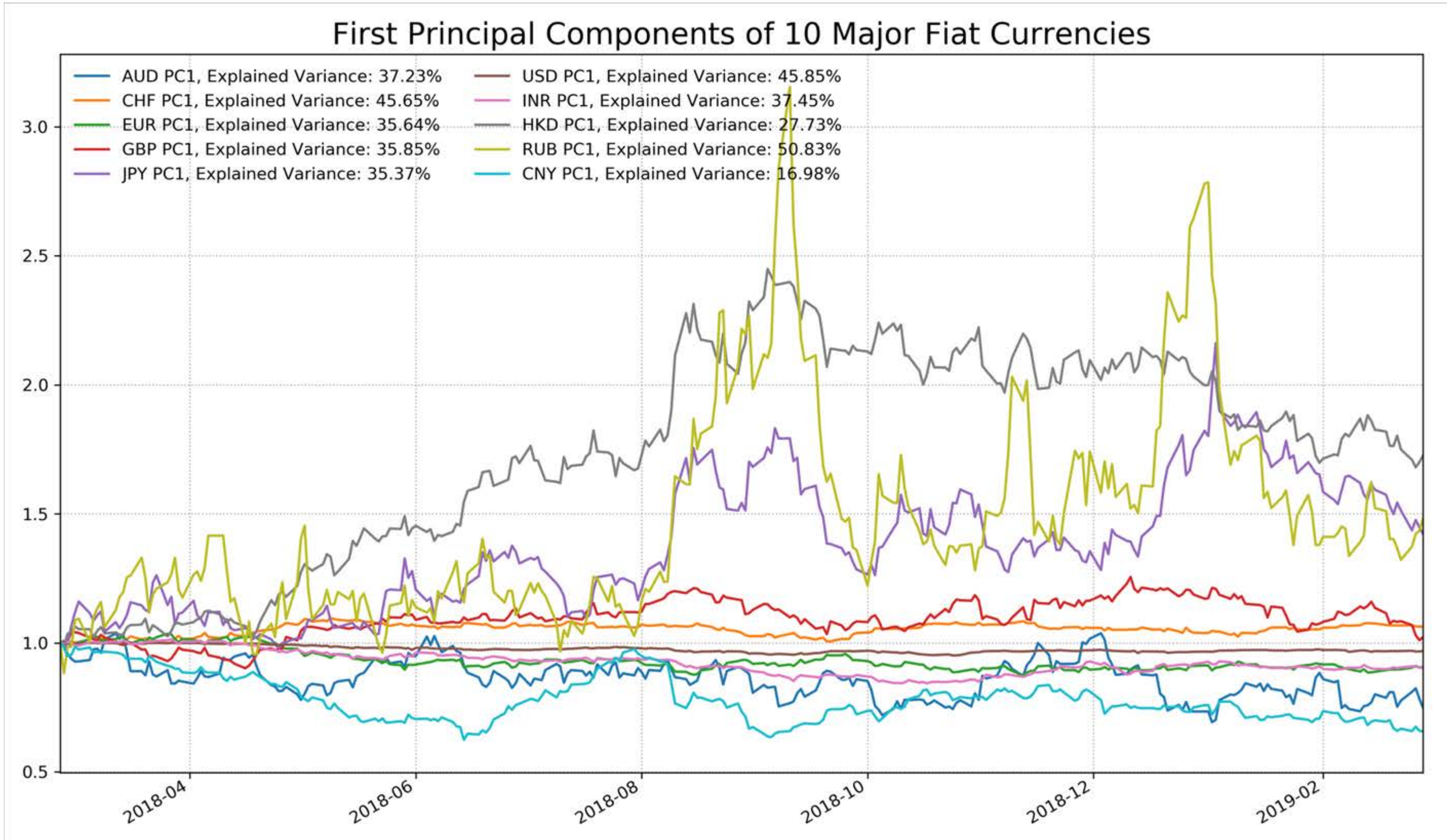
	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration $[days]$	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} $[days]$	Scenario Probability [%]
Positive Bubbles								
1	Palladium ER Index	47	162	84	63	2019-03-10	8	68

The Palladium Excess Return Index has further grown during February, as compared to last month. By now, a bubble size of 47% (previously 39%) is reached, at a slightly risen indicator level of 84% (81%). In the last report, the predicted critical time was forecasted to 15th March 2019, while here, the predicted date is a bit earlier, at March 10th. Nevertheless, now, the scenario probability is approximately doubled with 68%, as compared to previous month's 33%. A large scenario probability is based on the existence of a much larger number of LPPLS calibrations that are coincident in their fit parameters, which strengthens the signal. This circumstance reinforces the conclusion that the asset might soon undergo a change of regime.



Palladium ER Index
Current Bubble
DS LPPL Confidence (Neg.Bubble)
DS LPPL Confidence (Pos.Bubble)
Cumulative Return
DS LPPL Confidence
50%
40%
30%
20%
10%
0%
-10%
-20%
1.0
0.8
0.6
0.4
0.2
0.0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2019
Feb

Currencies – PCA



There are no relevant results to show for the forex sector. The PCA analysis of the major currencies is shown above. On the following slide, the results for the cryptocurrency sector are depicted.

Cryptocurrencies

	Bubble Data					Cluster Analysis		
	Name	Bubble Size bs [%]	Duration $[days]$	DS LPPL Confidence ci [%]	Geometric Average $\sqrt{bs \cdot ci}$ [%]	Critical Time Prediction μ_{t_c}	σ_{t_c} $[days]$	Scenario Probability [%]
Positive Bubbles								
1	Theta-Token	121	200	10	35	2019-07-19	22	55
2	Binance-Coin	49	198	21	32	2019-07-26	26	57
3	Tether	16	120	20	18	2019-02-28	1	51

For the first time since the big crash of the global cryptocurrency market in December 2017, positive bubble signals for three cryptocurrencies exchange rate pairs (analyzed in USD) appear in our analysis. The calculated values of the DS LPPLS Confidence Indicator are still in the lower range, suggesting a small degree of super-exponential dynamics in the price. The measured durations of the bubbles are about three to six months. Interestingly, for the first two coins, we see critical time predictions for the second half of July 2019, which is more than a quarter in the future. This suggests that the bubbles – which have already reached remarkable sizes (but relative to the expected sizes of the CC market might still be small) – might still grow by a significant amount until the price level becomes unsustainable and it crashes.

Single Stocks

For 749 stocks, we calculate the bubble warning indicators as well as two financial strength indicators, which indicate the fundamental value of the stock and the growth capability respectively.

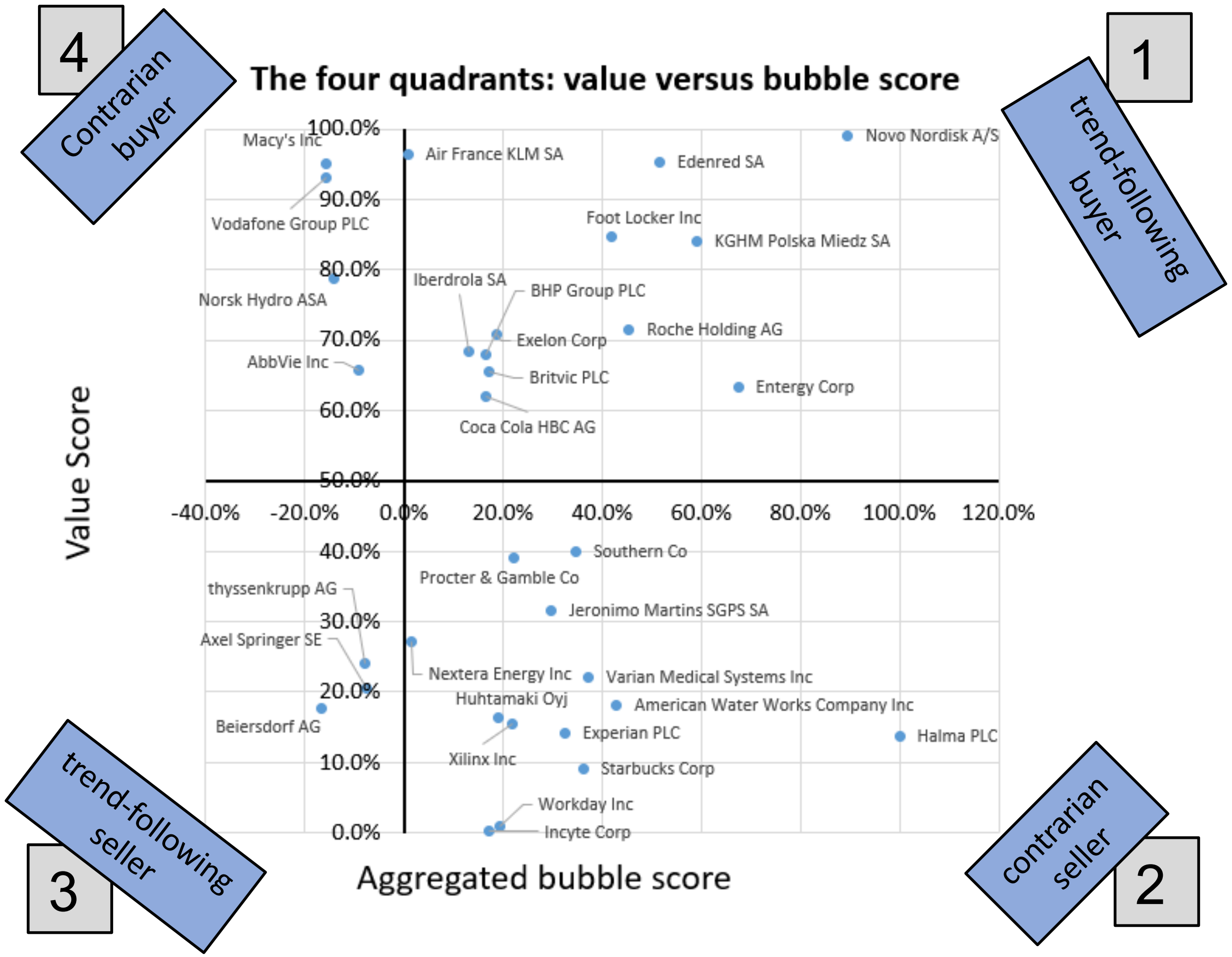
The stocks are the constituents of the Stoxx Europe 600, the S&P 500 and the Nasdaq 100 indices. From these, all doubles and stocks with incomplete data are removed. Because our financial strength indicators are specifically designed for corporates, all financial institutions are taken out of the set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

List of Indicators

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

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

Single Stocks



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

1. Quadrant 1: Stocks with a strong positive bubble score and a strong value score (e.g. Roche Holding AG);
2. Quadrant 2: Stocks with a strong positive bubble score and a weak value score (e.g. Workday Inc);
3. Quadrant 3: Stocks with a strong negative bubble score and a weak value score (e.g. Beiersdorf AG);
4. Quadrant 4: Stocks with strong negative bubble score and a strong financial strength (e.g. Macy's Inc)

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

Single Stocks

Each quadrant has its own specs:

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

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

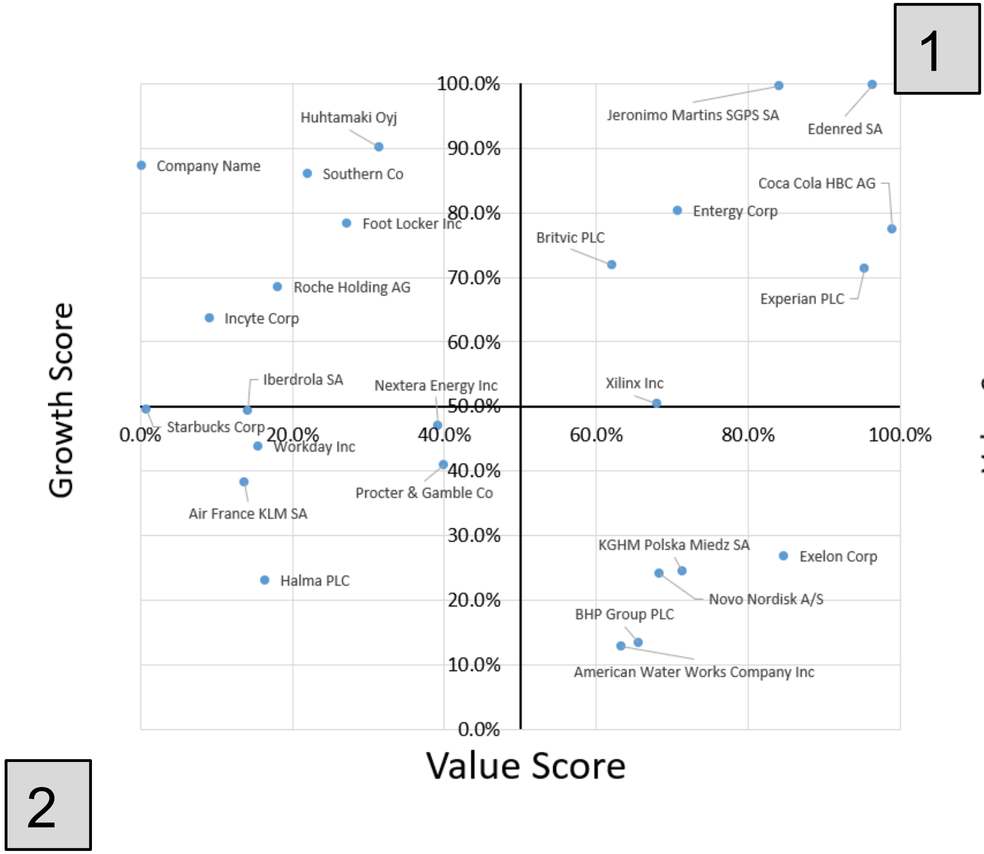
3. Quadrant 3: These stocks are expensive relative to their earnings potential. On top of that, there are clear negative bubble signals. Such stocks should be considered as falling knives. As an investor, one could be a trend-following seller.

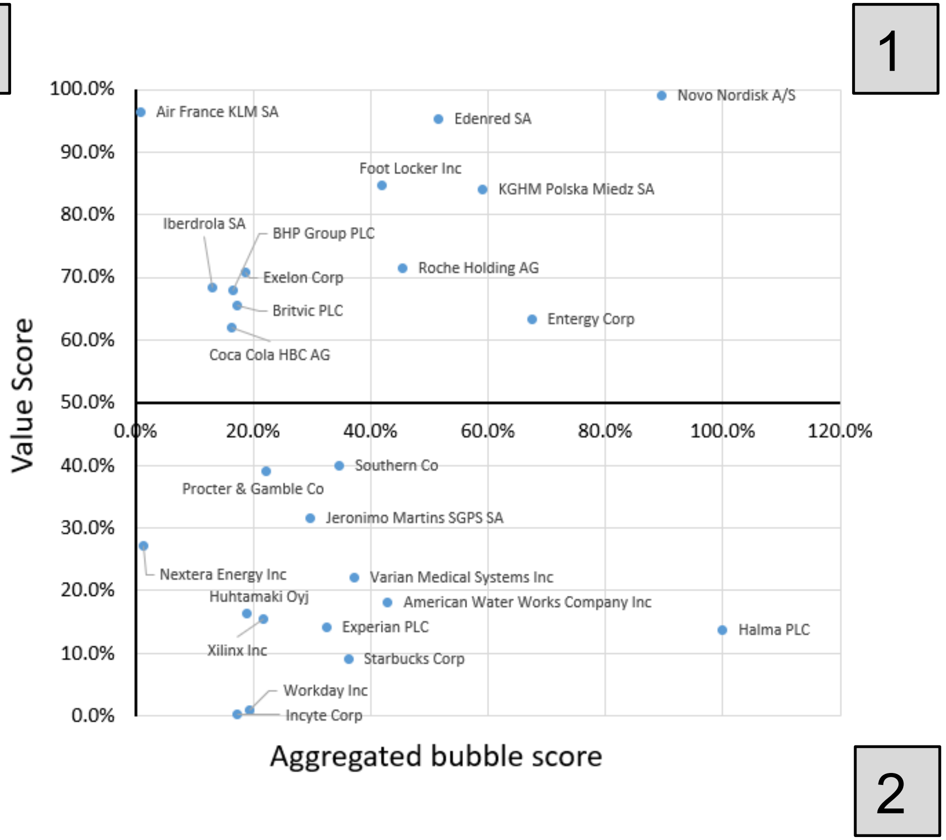
4. Quadrant 4: These stocks are cheap relative to their financial performance. The strong negative bubble signal is an indication of sentiment and herding. These stocks can be considered as over-sold. As an investor, one could be a contrarian buyer.

Single Stocks

Quadrants 1 and 2 (stocks)

Strong positive bubble signals with strong (respectively weak) fundamentals

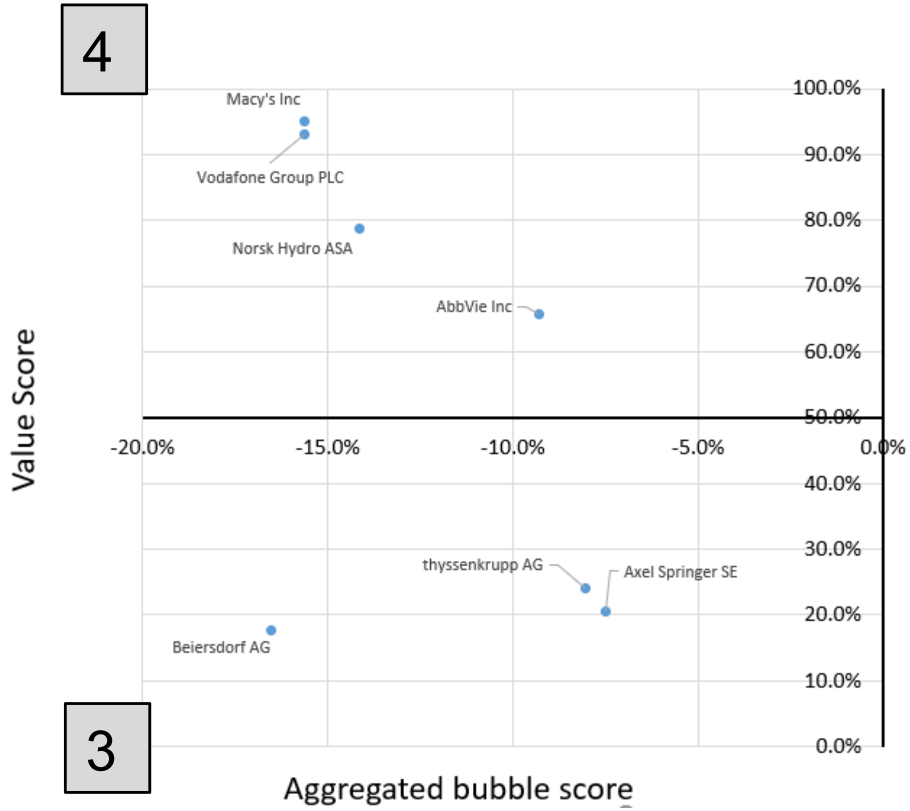




Single Stocks

Quadrants 3 and 4 (stocks)

Strong negative bubble signals with weak (respectively strong) fundamentals



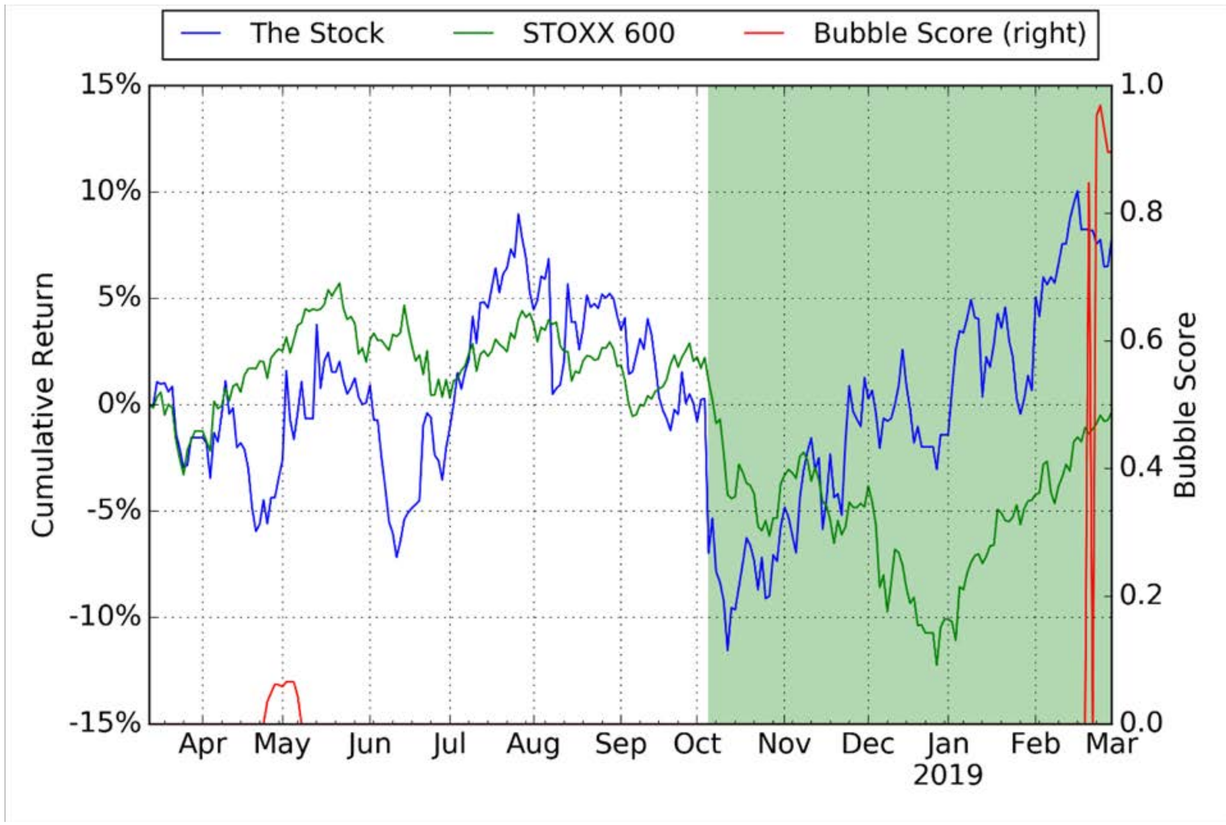
Single Stocks

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals

Company Name	Country of Headquarters	GICS Industry Group Name	Yearly Return	Bubble Size	Bubble Start	Bubble Score	Value Score	Growth Score
BHP Group PLC	United Kingdom	Materials	21.1%	10.7%	Oct-18	16.6%	68.0%	50.3%
Britvic PLC	United Kingdom	Food, Beverage & Tobacco	33.0%	21.9%	Oct-18	17.2%	65.6%	13.4%
Coca Cola HBC AG	Switzerland	Food, Beverage & Tobacco	1.1%	8.5%	Oct-18	16.4%	62.1%	71.8%
Novo Nordisk A/S	Denmark	Pharmaceuticals, Biotechnology & Life Sciences	6.7%	15.9%	Oct-18	89.6%	99.1%	77.4%
Iberdrola SA	Spain	Utilities	27.0%	19.1%	Sep-18	13.0%	68.4%	24.0%
Edenred SA	France	Commercial & Professional Services	34.3%	22.5%	Oct-18	51.6%	95.3%	71.4%
Air France KLM SA	France	Transportation	21.1%	56.8%	May-18	0.8%	96.4%	99.9%
KGHM Polska Miedz SA	Poland	Materials	-1.2%	18.7%	Oct-18	59.1%	84.1%	99.6%
Roche Holding AG	Switzerland	Pharmaceuticals, Biotechnology & Life Sciences	25.4%	16.2%	Jul-18	45.5%	71.4%	24.4%
Entergy Corp	United States of America	Utilities	20.3%	16.3%	Sep-18	67.5%	63.3%	12.8%
Exelon Corp	United States of America	Utilities	28.2%	16.0%	Jul-18	18.7%	70.8%	80.2%
Foot Locker Inc	United States of America	Retailing	45.1%	27.1%	Jul-18	42.0%	84.8%	26.8%

Single Stocks - Quadrant 1 stocks

Quadrant 1 stocks: strong positive bubble signals with strong fundamentals
Example: Novo Nordisk A/S.



The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the strong positive bubble we identified. The Bubble Score of this five month bubble has reached 89.6% with a bubble size 15.9%.

Single Stocks - Quadrant 1 stocks

Last month example: strong positive bubble signals with strong fundamentals, Iberdrola 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. The stock continued its appreciation in the past month, which is in agreement with the strong fundamentals, but not with the DS LPPLS indicator.

Single Stocks - Quadrant 2 stocks

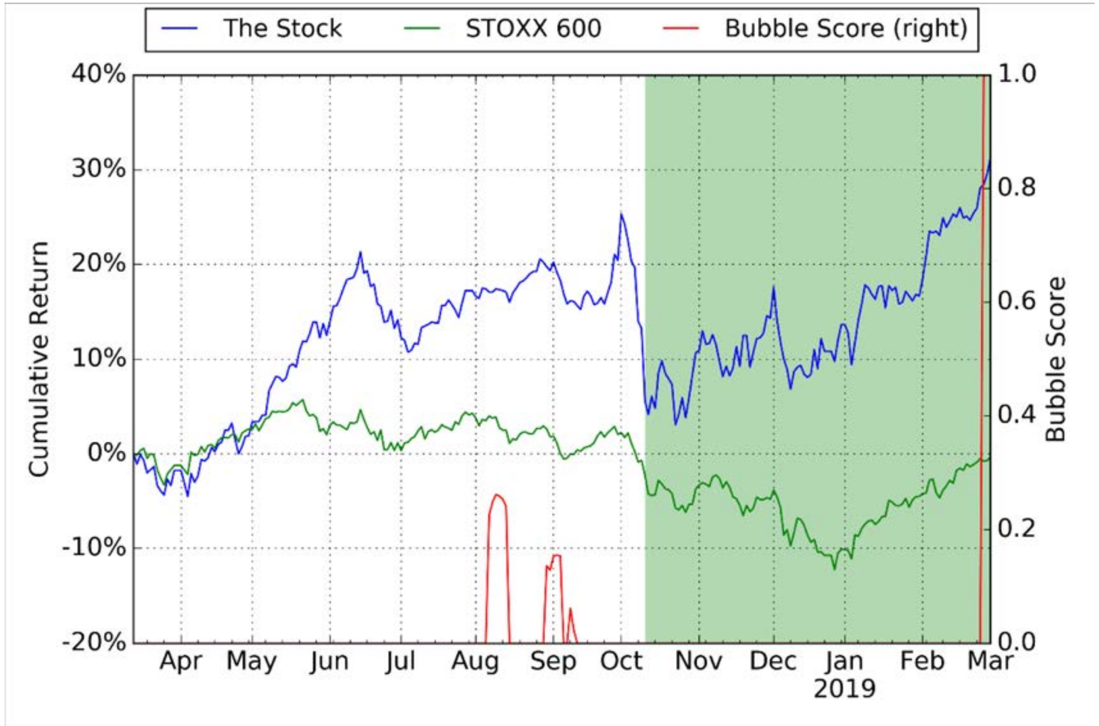
Entrepreneurial Risks
ETH zürich

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
Incyte Corp	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	-0.6%	38.1%	Oct-18	17.3%	0.1%	87.3%
Starbucks Corp	United States of America	Consumer Services	19.3%	19.3%	Mar-18	36.2%	9.1%	63.7%
Workday Inc	United States of America	Software & Services	38.6%	42.8%	Oct-18	19.3%	0.8%	49.5%
Xilinx Inc	United States of America	Semiconductors & Semiconductor Equipment	67.0%	79.1%	Apr-18	21.8%	15.5%	43.8%
Experian PLC	Ireland; Republic of	Commercial & Professional Services	22.4%	11.6%	Oct-18	32.5%	14.2%	49.3%
Halma PLC	United Kingdom	Technology Hardware & Equipment	31.4%	24.3%	Oct-18	100.0%	13.8%	38.3%
Huhtamaki Oyj	Finland	Materials	-11.8%	21.2%	Oct-18	18.9%	16.4%	23.0%
Jeronimo Martins SGPS SA	Portugal	Food & Staples Retailing	-10.8%	15.1%	Oct-18	29.8%	31.5%	90.1%
American Water Works Company Inc	United States of America	Utilities	24.5%	22.2%	May-18	43.0%	18.2%	68.5%
Nextera Energy Inc	United States of America	Utilities	18.6%	14.2%	Jun-18	1.4%	27.2%	78.2%
Procter & Gamble Co	United States of America	Household & Personal Products	25.1%	33.4%	Apr-18	22.2%	39.1%	47.0%
Southern Co	United States of America	Utilities	13.8%	17.0%	Sep-18	34.7%	39.9%	41.0%
Varian Medical Systems Inc	United States of America	Health Care Equipment & Services	9.0%	20.3%	Aug-18	37.3%	22.0%	86.0%

Single Stocks - Quadrant 2 stocks

Quadrant 2 stocks: strong positive bubble signals with weak fundamentals
Example: Halma PLC.

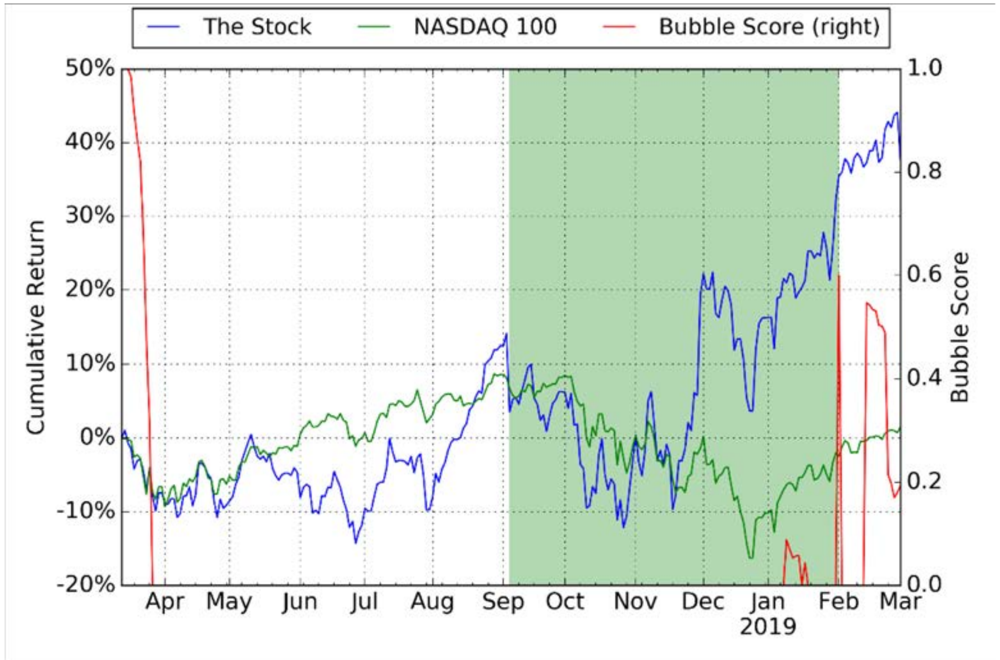


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The green shaded period is the positive bubble we identified. The Bubble Score of this five month bubble has reached 100% with a bubble size 24.3%. 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, Workday 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 has started a small correction in recent days after a further draw up at the beginning of the past month, which is in agreement with the weak fundamentals and our DS LPPLS indicator. However, one should remain cautious as the stock is still identified with strong positive bubble signal this month.



Single Stocks - Quadrant 3 stocks

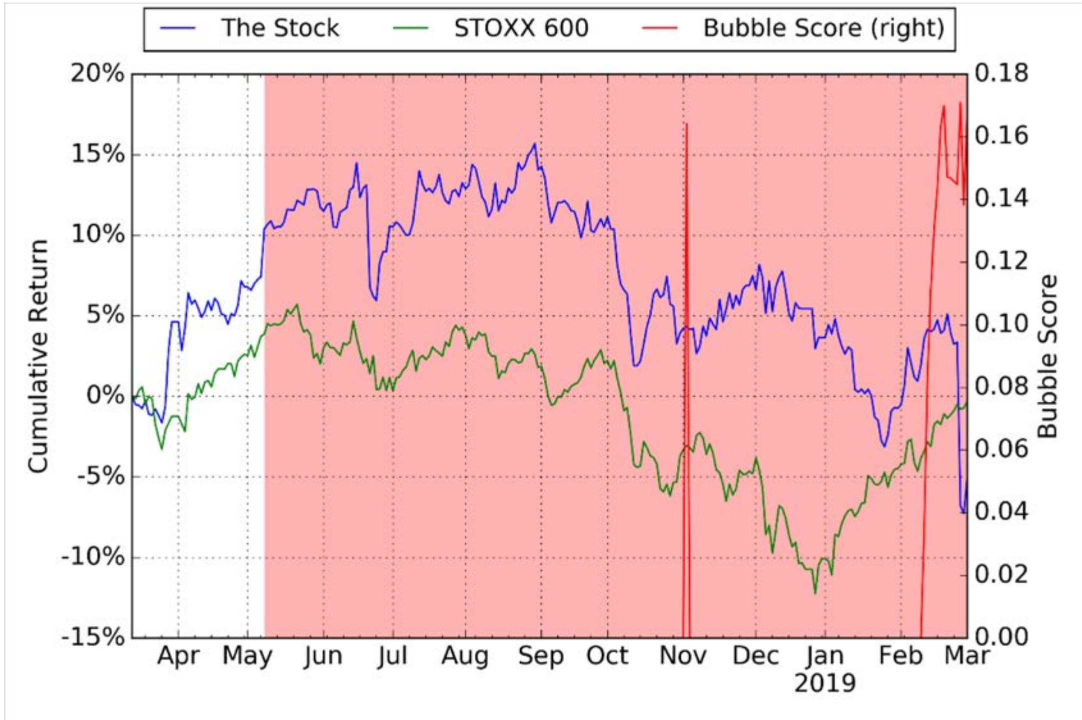
Entrepreneurial Risks
ETH zürich

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
Beiersdorf AG	Germany	Household & Personal Products	-4.7%	-14.1%	May-18	-16.5%	17.6%	89.5%
Axel Springer SE	Germany	Media & Entertainment	-24.9%	-24.9%	Apr-18	-7.5%	20.4%	88.1%
thyssenkrupp AG	Germany	Materials	-39.3%	-39.3%	Mar-18	-8.0%	24.0%	2.3%

Single Stocks - Quadrant 3 stocks

Quadrant 3 stocks: strong negative bubble signals with weak fundamentals
Example: Beiersdorf AG.

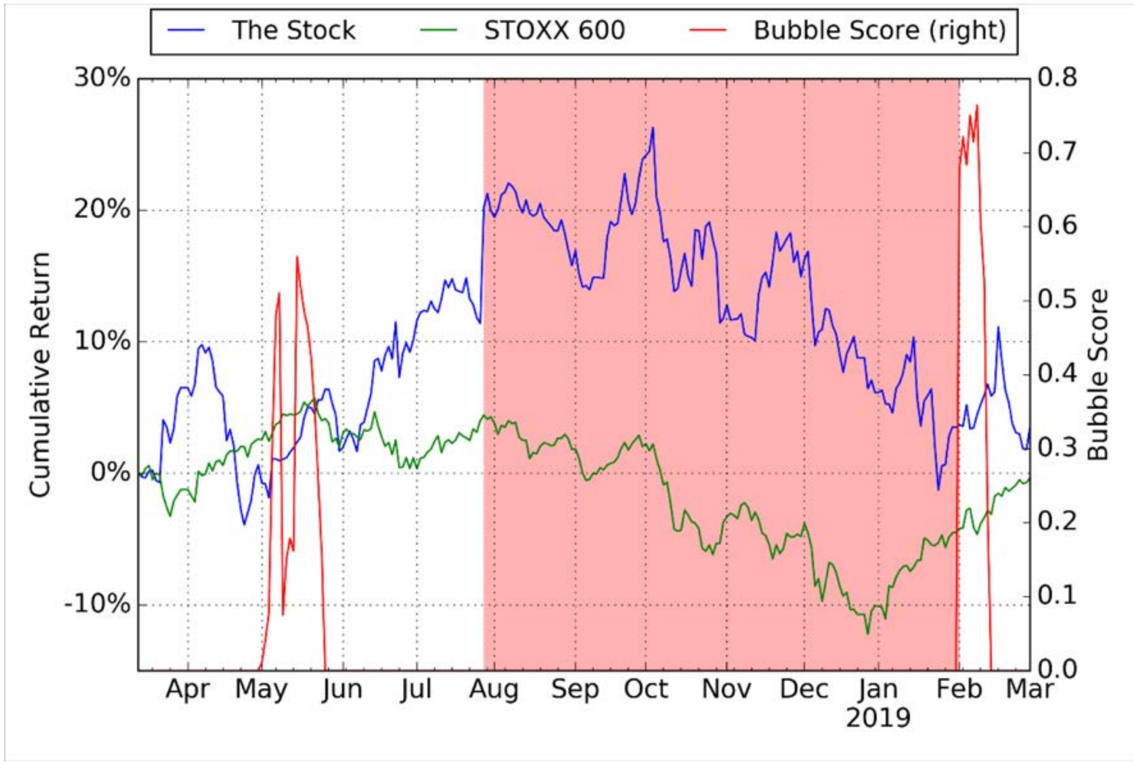


The above graph shows the one year cumulative return of the stock in blue (left hand scale), STOXX 600 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the negative bubble we identified. The Bubble Score of this ten month bubble has reached 16.5% with a bubble size -14.1%.

Single Stocks - Quadrant 3 stocks

Last month example: strong negative bubble signals with weak fundamentals, Reckitt Benckiser Group PLC.

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



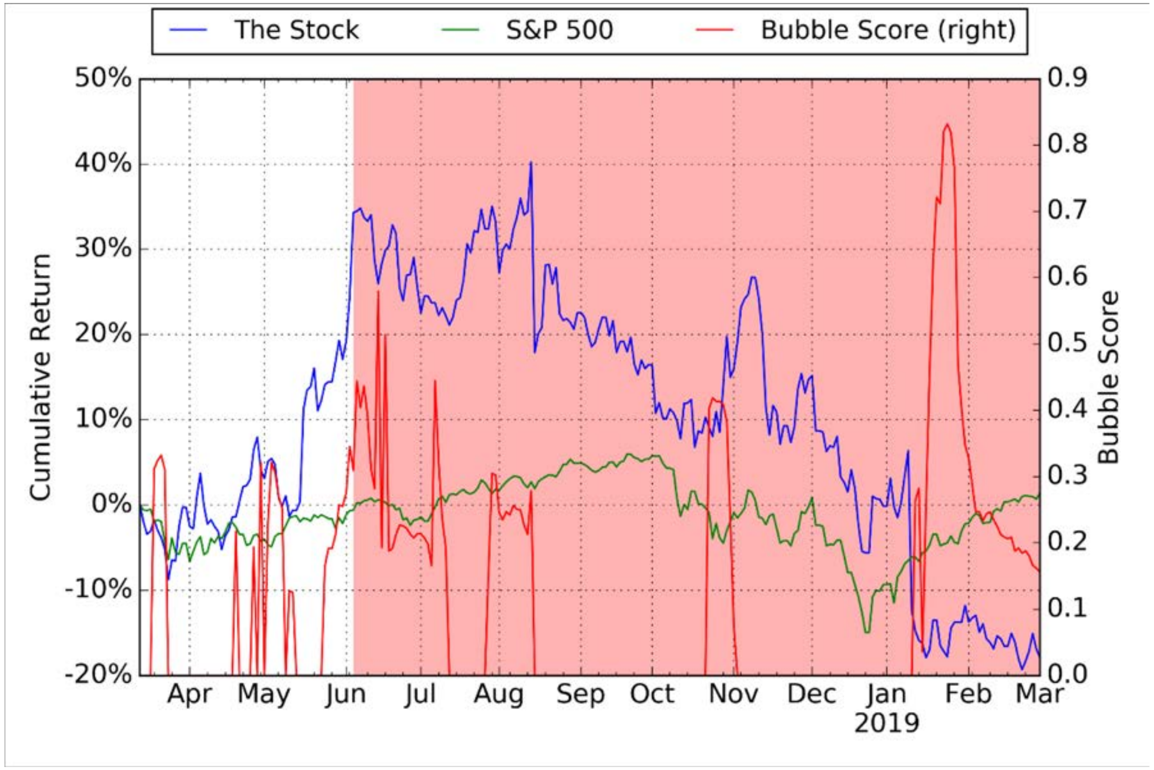
Single Stocks - Quadrant 4 stocks

Entrepreneurial Risks
ETH zürich

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
Norsk Hydro ASA	Norway	Materials	-28.6%	-33.1%	Jun-18	-14.2%	78.6%	94.5%
AbbVie Inc	United States of America	Pharmaceuticals, Biotechnology & Life Sciences	-30.3%	-22.1%	May-18	-9.3%	65.7%	73.4%
Macy's Inc	United States of America	Retailing	-15.0%	-38.9%	Jun-18	-15.6%	95.1%	4.7%
Vodafone Group PLC	United Kingdom	Telecommunication Services	-33.3%	-31.9%	Apr-18	-15.6%	93.1%	2.7%

Quadrant 4 stocks: strong negative bubble signals with strong fundamentals
Example: Macy's Inc.

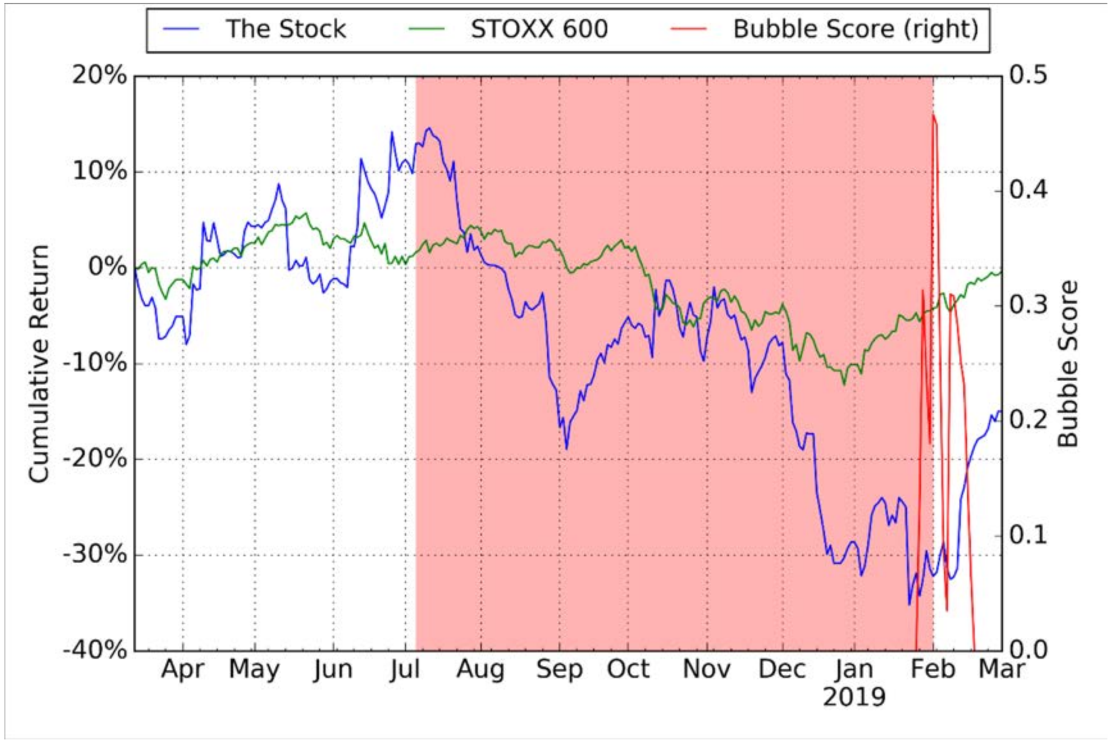


The above graph shows the one year cumulative return of the stock in blue (left hand scale), S&P 500 in green (left hand scale) and the calculated DS LPPLS Bubble Score in red (right hand scale). The red shaded period is the strong negative bubble we identified. The Bubble Score of this nine month bubble has reached 15.6% with a bubble size -38.9%. 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, Ingenico Group 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 stopped its drawdown and started a strong rebound in the past month, which is in agreement with our DS LPPLS indicator and the strong fundamentals.



Sectors

GICS Industry Group Name	Yearly Return		Bubble Size		Bubble Score		Value Score		Growth Score	
	Mar 1st	Feb 1st	Mar 1st	Feb 1st	Mar 1st	Feb 1st	Mar 1st	Feb 1st	Mar 1st	Feb 1st
Pharmaceuticals, Biotechnology & Life Sciences	6.2%	2.9%	0.0%	0.0%	0.0%	0.0%	68.5%	66.2%	52.6%	49.0%
Consumer Services	-0.7%	-3.0%	0.0%	0.0%	0.0%	0.0%	32.4%	31.5%	50.7%	48.4%
Retailing	3.9%	3.5%	0.0%	0.0%	0.0%	0.0%	20.4%	18.4%	55.7%	58.5%
Transportation	1.5%	-2.3%	0.0%	0.0%	0.0%	0.0%	57.5%	62.4%	50.7%	49.7%
Consumer Durables & Apparel	-1.7%	-6.2%	0.0%	0.0%	0.0%	0.0%	37.3%	37.0%	59.2%	59.4%
Semiconductors & Semiconductor Equipment	-11.5%	-9.9%	0.0%	0.0%	0.0%	0.0%	64.1%	62.2%	38.7%	30.3%
Technology Hardware & Equipment	-2.0%	-3.9%	0.0%	0.0%	0.0%	0.0%	68.9%	74.1%	41.5%	41.9%
Automobiles & Components	-17.1%	-19.2%	0.0%	0.0%	0.0%	0.0%	74.6%	77.6%	56.5%	52.9%
Telecommunication Services	-6.5%	-8.2%	0.0%	0.0%	0.0%	0.0%	67.4%	66.1%	32.3%	35.6%
Energy	0.3%	-3.6%	0.0%	0.0%	0.0%	0.0%	53.2%	53.2%	51.0%	46.4%
Software & Services	6.5%	2.9%	0.0%	0.0%	0.0%	0.0%	37.8%	39.6%	47.1%	47.5%
Materials	-8.6%	-13.1%	0.0%	0.0%	0.0%	0.0%	54.4%	53.1%	46.8%	43.3%
Health Care Equipment & Services	9.0%	8.8%	0.0%	0.0%	0.0%	0.0%	61.8%	68.5%	52.8%	59.1%
Capital Goods	-6.9%	-12.5%	0.0%	0.0%	0.0%	0.0%	46.6%	47.9%	50.7%	51.0%
Media & Entertainment	10.0%	3.6%	0.0%	0.0%	0.0%	0.0%	37.8%	30.7%	43.0%	52.6%
Commercial & Professional Services	6.4%	3.8%	0.0%	0.0%	0.0%	0.0%	34.2%	34.5%	49.8%	51.2%
Food & Staples Retailing	8.5%	1.1%	0.0%	0.0%	0.0%	0.0%	53.6%	52.2%	55.4%	64.3%
Household & Personal Products	7.4%	1.8%	0.0%	0.0%	0.0%	0.0%	37.1%	37.3%	49.5%	50.5%
Food, Beverage & Tobacco	-6.4%	-9.6%	0.0%	0.0%	0.0%	0.0%	48.5%	45.8%	59.0%	59.1%
Utilities	10.3%	9.5%	0.0%	0.0%	0.0%	0.0%	51.6%	53.3%	43.5%	44.7%
Insurance	-2.8%	-7.4%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Real Estate	4.7%	6.1%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Diversified Financials	-11.0%	-12.3%	0.0%	0.0%	0.0%	0.0%	-	-	-	-
Banks	-14.8%	-19.0%	0.0%	0.0%	0.0%	0.0%	-	-	-	-

Portfolio Construction & Performance

Entrepreneurial Risks
ETH zürich

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

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

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

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

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

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

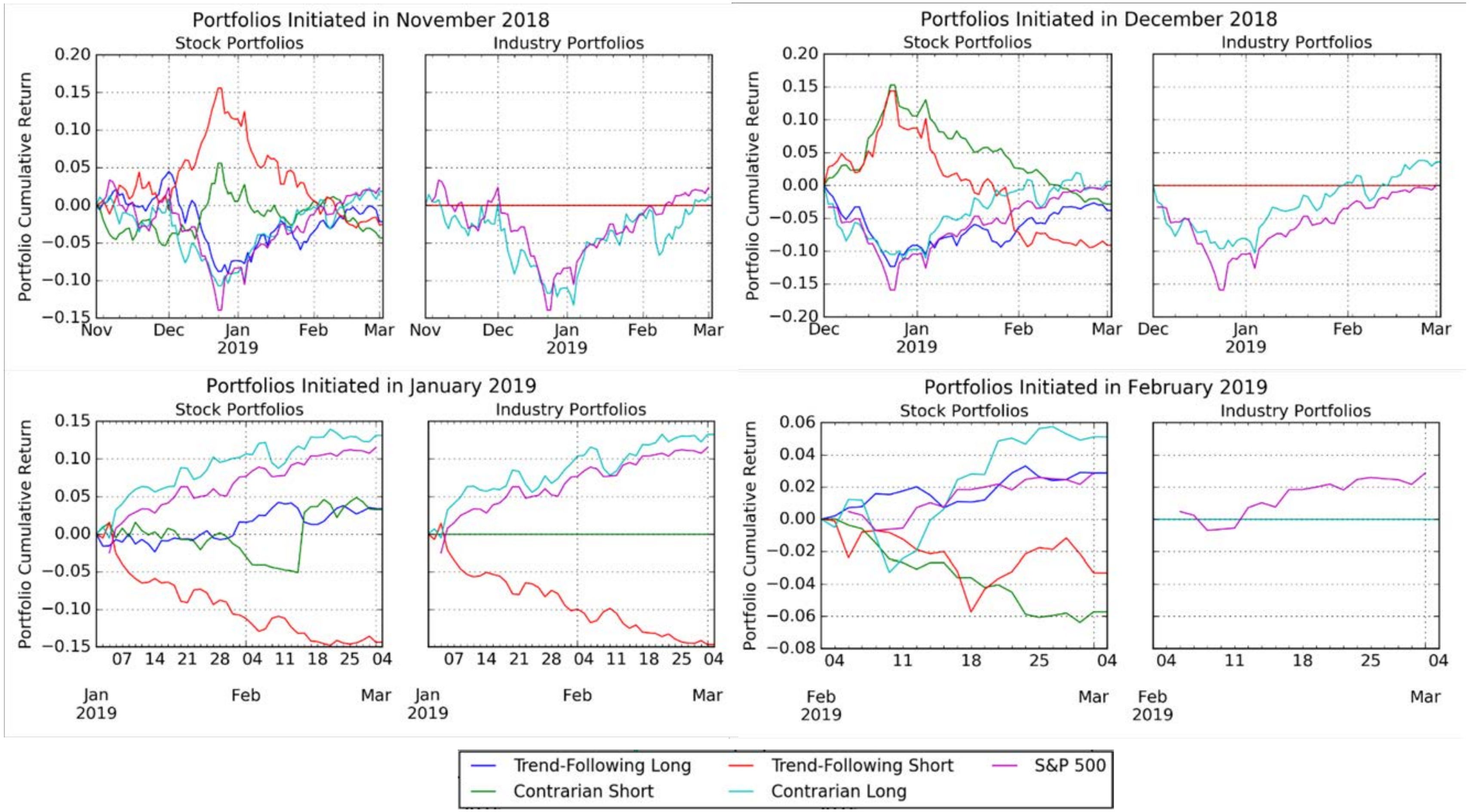
Portfolio Construction & Performance

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

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

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

Portfolio Construction & Performance



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

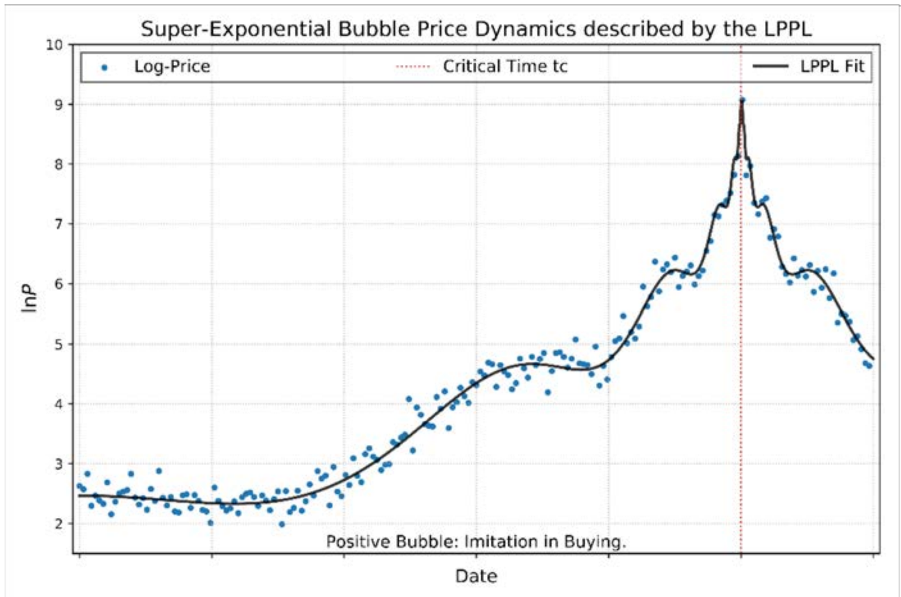
Appendix

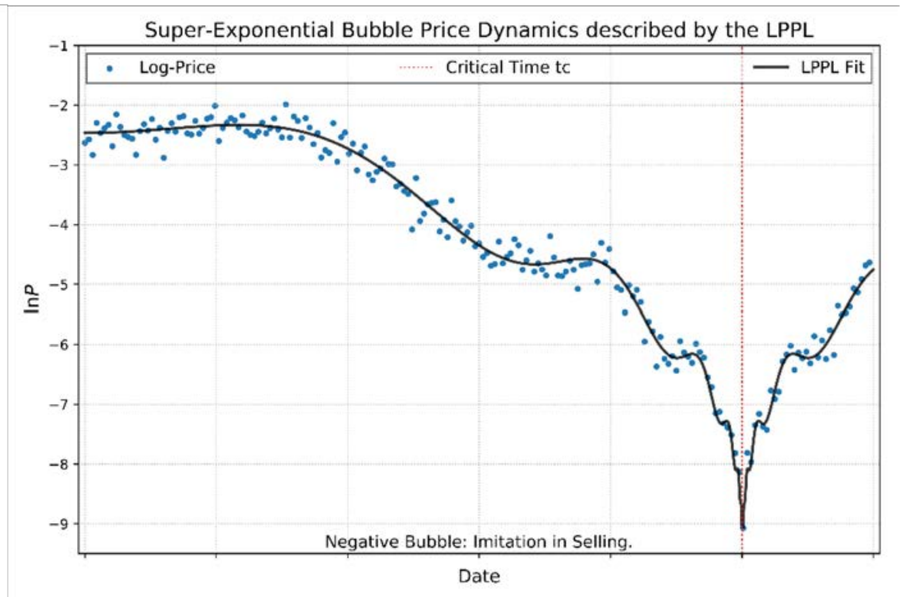
Methodology

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

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

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





The LPPLS Model

Entrepreneurial Risks
ETH zürich

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:

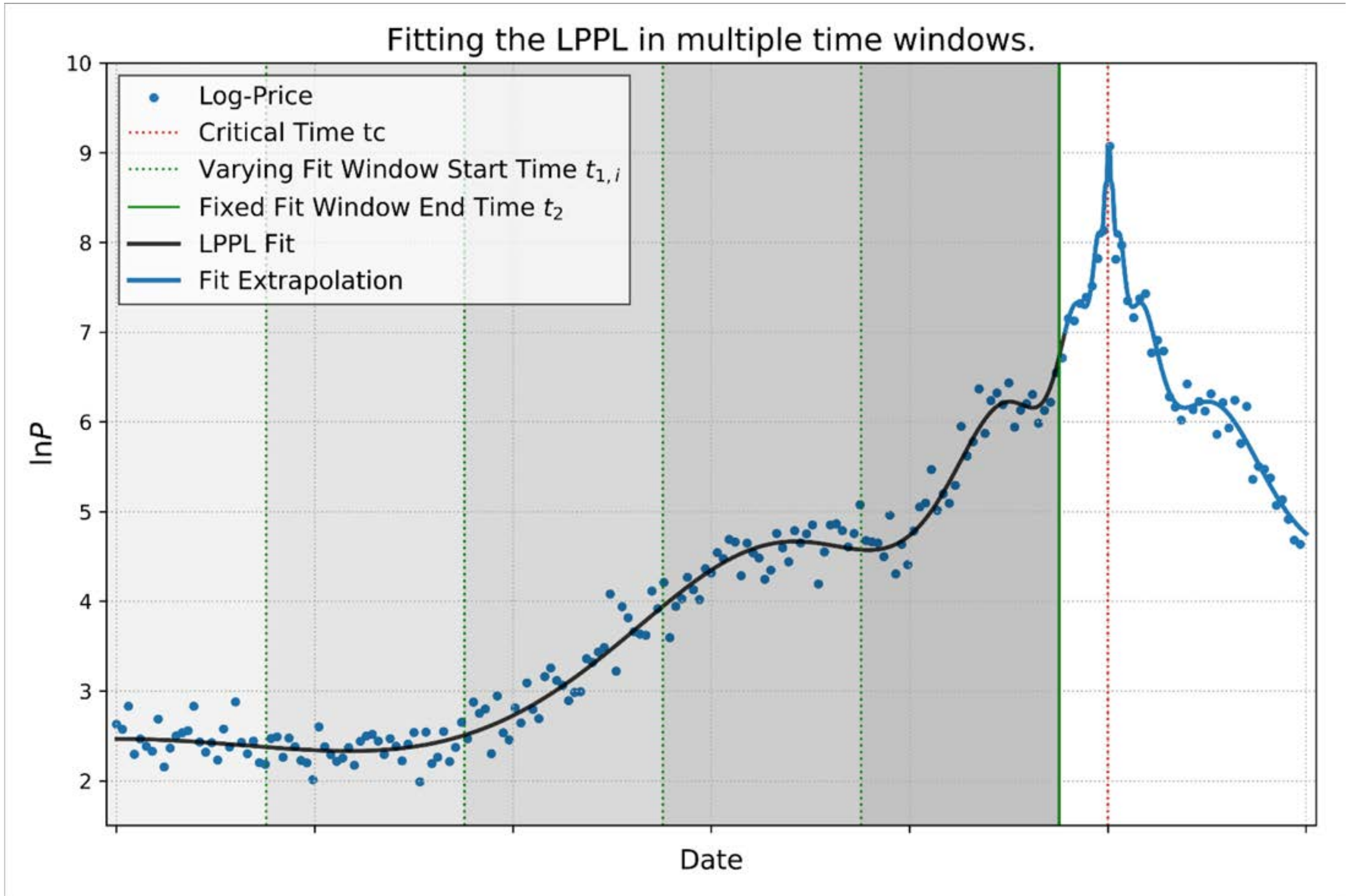
$$LPPLS \coloneqq E[\ln P(t)] = A + B(t_c - t)^m + (t_c - t)^m [C_1 \cos(\omega \ln(t_c - t)) + C_2 \sin(\omega \ln(t_c - t))]$$

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

Entrepreneurial Risks
ETH zürich

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

Entrepreneurial Risks
ETH zürich

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.

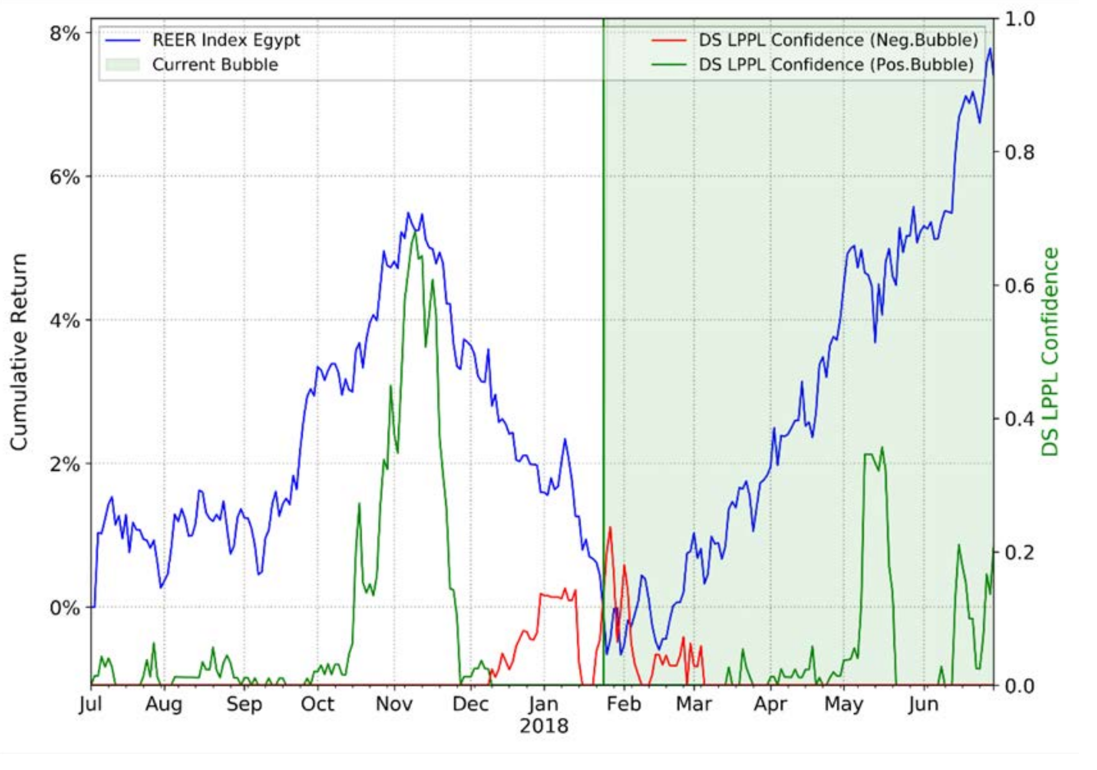
The first section provides asset and estimated bubble characteristics (size and duration), as well as the value of the confidence indicator. We rank assets according to their geometric average of the absolute of bubble size and confidence indicator. In this way, we incorporate the bubble size into the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

Entrepreneurial Risks
ETH zürich

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

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

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

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

Currencies – Principal Component Analysis

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

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

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

Value and Growth Score

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

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

Visit the Financial Crisis Observatory for more information

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