Bubble prediction & Mean reversion

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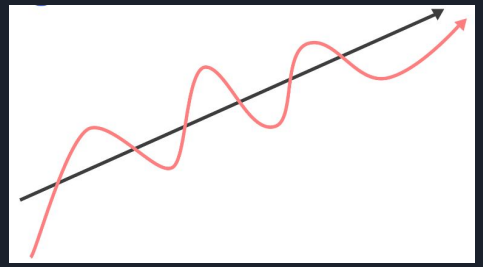
Outline

- Mean reversion
- Strategy Explanation
- Critiques
- LPPLS Explanation
- Implementation
- Results
- Discussion
- Future Research

Mean Reversion - Background



- Asset prices return to their long term average - Predictable
- In a 1965 paper, Eugene Fama presented “strong and voluminous evidence in favour of the random-walk hypothesis” (Fama, 1965) - Unpredictable
- Later contradicted this view when Fama & French (1988) found mean reversion occurred in long timeframes (3-5 years)
- Rosenberg et al. (1998) found mean reversion occurred in shorter timeframes
- Why does Mean reversion occur?
    - Price divergence from fundamentals is “eliminated by speculative forces” (Poterba & Summers, 1988)
    - Market Makers inventory - Compensation for bearing inventory risk (Grossman & Miller 1988)
- Trading strategies
    - Pairs Trading, Moving Average crossovers, Portfolio Rebalancing

Short term stock reversal strategy

Groot, Guij and Zhou (2011)

- Screen the 100 stocks with the largest market cap. Take a long position in the ten stocks with the lowest performance in the previous week. Take a short position in the ten stocks with the highest performance in the previous month.
- Weekly rebalancing
- Quantconnect implementation (2000-2022)
  - Compounding Annual Return: 22%
  - Sharpe: 0.821


SPY Close Price
400
300
200
100
2000
2004
2008
2012
2016
2020
Date


10M
7.5M
5M
2.5M
0
Equity
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024


SPY Close Price
400
300
200
100
2000
2004
2008
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2016
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Date


10M
7.5M
5M
2.5M
0
Equity
2000
2002
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2010
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2018
2020
2022
2024

Pitfalls of Mean-Reversion

- Some price movements are not transitory - They may not revert to the mean
- Requires volatility in market to execute trades
- Short trading cycles lead to increased trading costs
- Missing profitability by closing out positions early

Pitfalls of Short term reversal strategy

- Poor performance during consistent growth
- Poor performance in more recent time periods
  - 2016-2021
    - Return of 16% compared to benchmark S&P 500 93%
    - Sharpe ratio of 0.2
  - 2005-2010
    - Return of 48% compared to benchmark S&P 500 93%
    - Sharpe ratio of 1.4
- High risk of contrarian trading during market downturns
- Liquidity and trading cost assumptions

Hypothesis - Using bubble predicting signals we can improve the performance of short-term mean reversion

Implementation

- Trade volume limits result in our model only being able to be tested in five year periods so we have chosen 2005-2010 and 2016-2021 because both of these periods include a sharp market correction.
- Starting equity of $100,000 USD
- Limited to US stocks

Implementation - Initial Results

2005-2010

Return: 48%

Sharpe Ratio: 1.4

2016-2021

Return: 3%

Sharpe Ratio: 0.2

Log-Periodic Power Singularity (LPPLS)

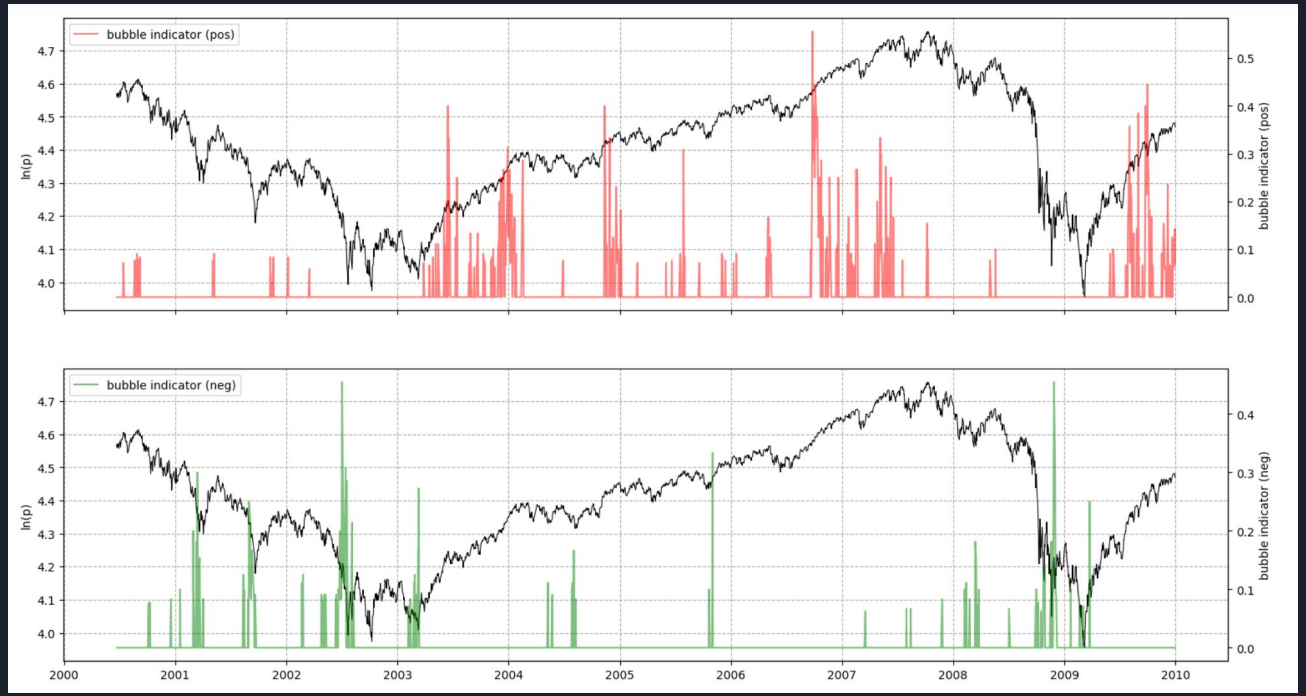
- We decided to implement an LPPLS model to assist with profitability of these market shifts.
- The LPPLS model identifies a ‘faster than exponential’ growth in an asset’s price for the purpose of diagnosing a ‘financial bubble’ and predicting a singular point of reversion towards a pre-existing mean.
- Can be used to identify and predict the formation of a negative downward growth pattern.

Log-Periodic Power Singularity (LPPLS) Cont.

- There are 3 ways to categorise a market's behaviour as a bubble:
    1. Faster than exponential growth (or decline) of the price.
    2. Accelerated succession of transient increases.
    3. Mean-reverting behaviour of the residuals.
- We hypothesis that we can use the LPPLS model to accurately predict a singular point of capitulation.
- Asset will be likely to revert towards its mean either from a relative low or high.
- Whilst an asset's price doesn't always necessarily revert towards its long-term moving average mean, implementing an LPPLS model into our trading strategy will ensure that any significant momentum shifts will be carefully analysed for trends which may exhibit exponential and unsustainable characteristics.

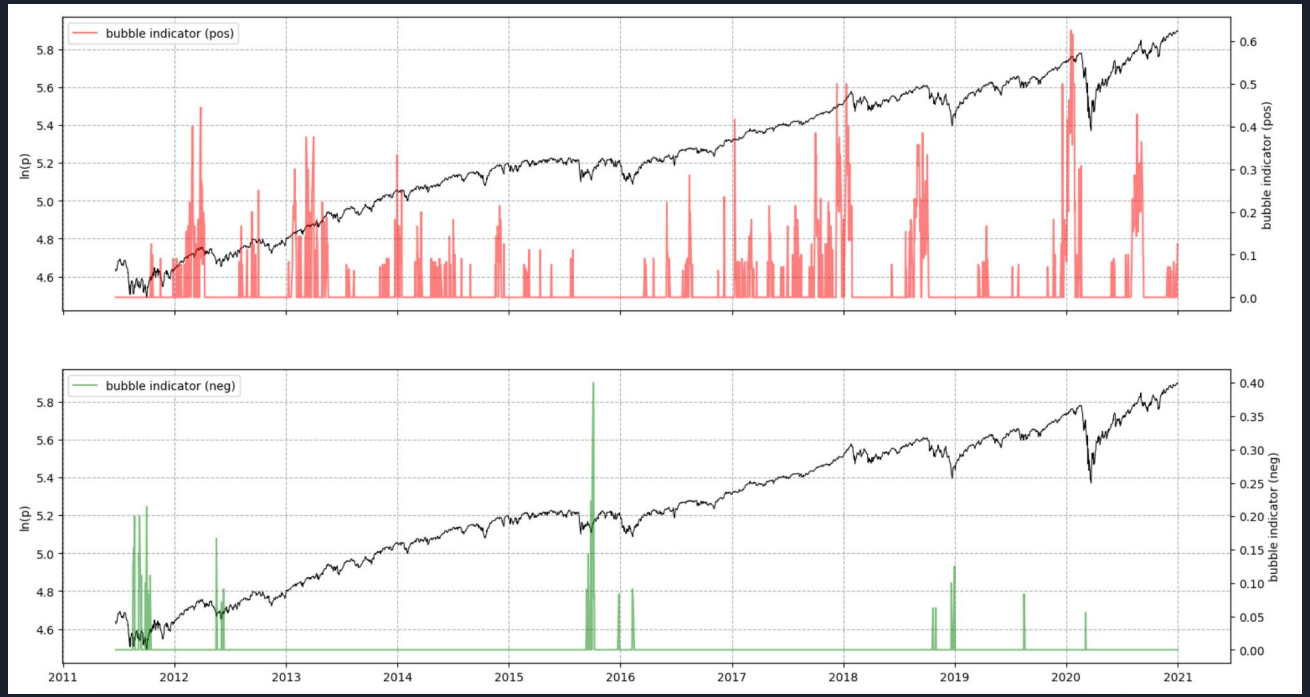
Implementation - LPPLS

2000-2010



Implementation - LPPLS

2011-2021



Implementation - Strategies

- Group A - Changing Aggression
  - Increase the strategy leverage when LPPLS indicates bubble, remove leverage when no bubble
  - Increase the strategy leverage when LPPLS indicates no bubble, remove leverage when bubble

- Group B - Seek bubble risk
  - Hold S&P 500 until LPPLS indicates bubble, then switch to short-term reversal
  - Hold S&P 500 until LPPLS indicates no bubble, then switch to short-term reversal

- Group C - Avoid bubble risk
  - Short-term reversal until LPPLS indicates bubble, then switch to S&P 500
  - Short-term reversal until LPPLS indicates no bubble, then switch to S&P 500

Results

Strategy	2005-2010 Return	2005-2010 Sharpe	2016-2021 Return	2016-2021 Sharpe
Increase the strategy leverage when LPPLS indicates bubble, remove leverage when no bubble	65.2%	1.638	1.8%	0.178
Increase the strategy leverage when LPPLS indicates no bubble, remove leverage when bubble	54%	1.321	-	-
Hold S&P 500 until LPPLS indicates bubble, then switch to short-term reversal	19.7%	0.748	6.86%	0.367
Hold S&P 500 until LPPLS indicates no bubble, then switch to short-term reversal	**17.3%**	**0.688**	**-**	**-**
Short-term reversal until LPPLS indicates bubble, then switch to S&P 500	**19.3%**	**0.708**	**11.9%**	**0.588**
Short-term reversal until LPPLS indicates no bubble, then switch to S&P 500	**22.6%**	**0.809**	**-**	**-**

Discussion

- Leverage models exacerbate performance
  - Improves the performance of the already well performing 2005-2010, reduces the performance of the weak performing 2016-2021 - No that exciting

- Improved 2016-2021 sharpe from 0.2 to 0.58
  - Indicates in more recent time frames a strategy that can switch between S&P 500 and a mean reverting strategy could improve performance
  - Perhaps due to non-transitory price movements

- No negative bubble prediction during 2016-2021
  - Lack of data to make judgements on this time frame. We could reduce the threshold to explore the performance

Future Research

- Explore cryptocurrency universe
- Implement our proposed improvements and analyse how it performs historically in a market with more volatility.

Thankyou