LONG ONLY MACRO SIGNAL STRATEGY

Presented by Team Macrostructure (Beginner entry)

Hypothesis

SPDR S&P 500 ETF Trust (ticker: SPY) aims to keep track of S&P 500 index, or in a larger sense, serves as the main benchmark to US equity market. We can explore "in" and "out" signal of SPY by examining macro correlated factors to equity market.

- **Industrials**: Industrial products are production inputs for most sectors and early in value chain -> market value drop in this sector -> early warning to border market
- **Commodities**: Resources e.g.metals/crude oil -> necessary input for most industries -> drop in price -> warning to border market
- **Debt market**: Decreases in bond yields (i.e. increase in bond price) -> warning sign to slow down in equity market growth
- **Forex market**: Strong dollar -> pressure on equity -> weaker correlation than the factors above -> require further backtest

Signal sources (i)

Commodity

- DBB ETF (Invesco DB Base Metals Fund)
- Excludes crude oil (USO) as signal source (too volatile)
- Another alternative is JJM (arguably cleaner signal), but it only introduced after the required holding period
- High correlation to industrial metals future contract
- Good signal to commodity price changes
- Bear signal: 8% drop in price over the past 90 trading days

	DBB	JJM	alu_future	cu_future
DBB	1.000000	0.993622	0.926301	0.877370
JJM	0.993622	1.000000	0.908479	0.900709
alu_future	0.926301	0.908479	1.000000	0.755092
cu_future	0.877370	0.900709	0.755092	1.000000

Debt market

- SHY ETF (iShares 1-3 Year Treasury bond)
- Tracks short-term treasury bond yield and prices
- Offers exposure to short end maturity curve
- High correlation to two year TNote future - ticker "TU"
- Bear signal: 50 basis point drop over the past 90 trading days

	DBB	XME	TLT	IEF	SHY	TU	TY
DBB	1.000000	0.578379	-0.297532	-0.261573	-0.150821	-0.145149	-0.241713
XME	0.578379	1.000000	-0.353805	-0.299633	-0.135602	-0.141160	-0.283087
TLT	-0.297532	-0.353805	1.000000	0.920349	0.574750	0.560503	0.856193
IEF	-0.261573	-0.299633	0.920349	1.000000	0.745707	0.729464	0.969299
SHY	-0.150821	-0.135602	0.574750	0.745707	1.000000	0.905931	0.779329

Signal sources (ii)

Industrials

- XLI ETF (Industrial Select Sector SPDR® Fund)
- Provide precise exposure to companies in industrial sectors (e.g. Airlines, building products, machinery, air freight and logistics)
- Bear signal: 8% drop in price over the past 90 trading days

Forex market

- UUP ETF (Invesco DB US Dollar Index Bullish Fund)
- it rises in value as the dollar appreciates relative to a basket of world currencies.
- Bear condition: 8% gain over the past 90 trading days

Algorithm logic

Scenario 1: "SPY out of the market"

- When a bear signal from one of the four factors are triggered, implying a possible future turmoil. We invest in low volatile asset (i.e. IEF: iShares 7-10 Year Treasury Bond ETF) to give little return rather than completely out of market .
- We set a buffer period of 15 trading days to escape from the turmoil. Once 15 trading days have passed without new bear signal, it will be "in" the market.

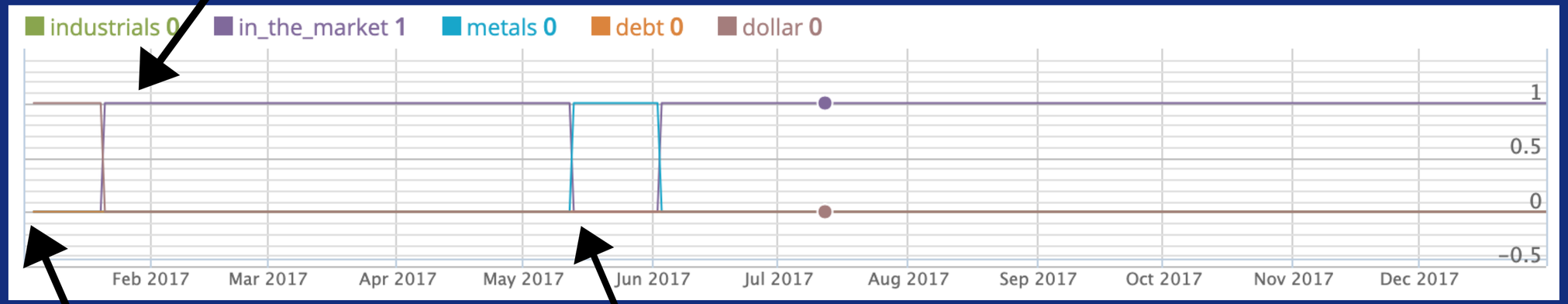
Scenario 2: "SPY in the market"

- If the latest bear signal is greater than 15 trading days, we are "in" the market and go long with SPY until next bear signal is triggered.

**refer to Appendix 1 for algo code (implemented via Quantopian platform*

Simulated example (2017)

In the market
(No new signals)



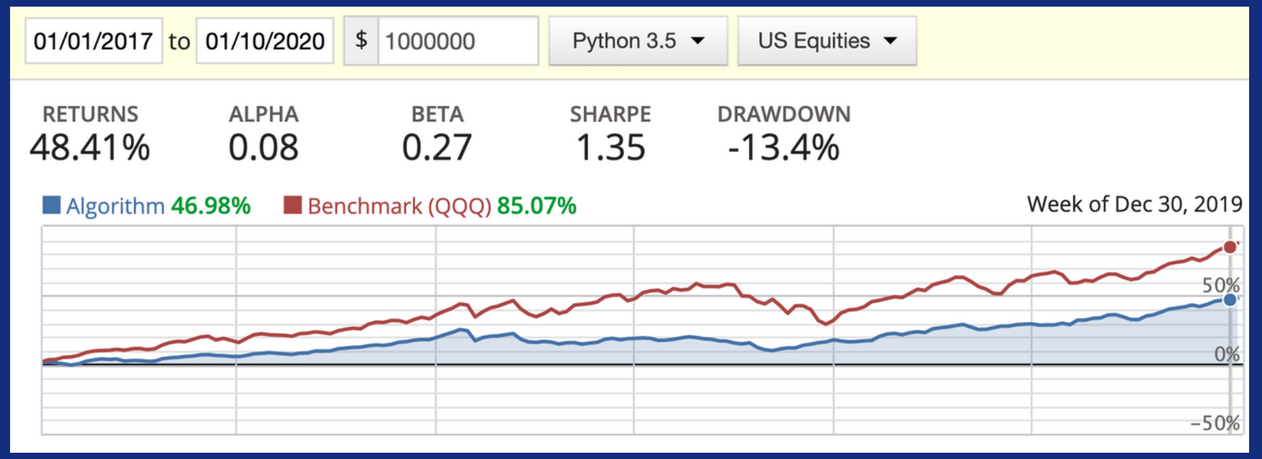
Out of market
(strong dollar signal)

Out of market
(Weak commodity signal)

Results

Competition holding period

- The Algo performs a total return of 48.41% from the holding period of 01/01/2017 - 01/10/2020
- The overall return underperform when compared to the benchmark (QQQ) but resulting a solid positive alpha when taking market volatility as consideration
- Promising sharpe ratio of 1.35



Extended holding period

- The algo outperform the benchmark for a longer holding period with very low volatility given by a beta of 0.07
- One surprising result is that metal acts as a clean signal in forecasting 2008 GFC and helps my portfolio survives out of market crush in Q4 2008 (refer to appendix 2)

Evaluation

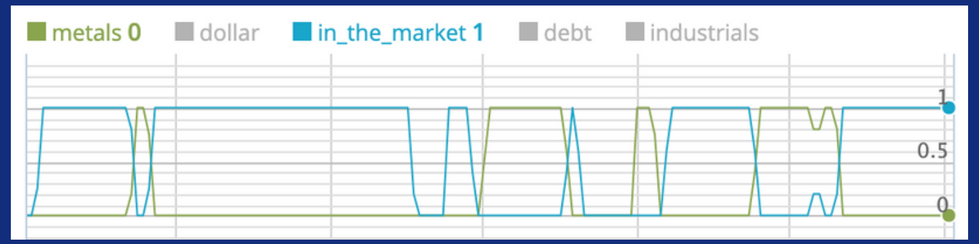
Sensitivity analysis

- The sensitivity table implies number of days "Out" of market creates significant market return volatility -> pay extra attention when further developing this model
- Further parameter optimisation found by taking 6% as XLI bear benchmark -> eliminate one false signal and continue stay in the market

Sensitivity table for the holding period: 1/1/2017 - 30/9/2020			
Suspension days	13	14	15
% of return	46.00%	48.41%	44.84%
Commodity (DBB)	6%	7%	8%
% of return	46.64%	48.41%	48.56%
Industrials (XLI)	6%	7%	8%
% of return	51%	48.41%	46%
Currecy	6%	7%	8%
% of return	44.51%	48.41%	47.91%

Improvement areas

- Cleaner metals signal: It's clear that metal constitutes most signal sources as shown in the graph. A cleaner signal can improve the algo significantly. Pure metals future contract might be an area to explore.
- Alternative signal sources: Trying a combination of other indicator or explore microstructure



Appendix 1 (Algo snippet)

```
    # Get the returns for basic metals, industrials and bonds
    # Get the cost of debt which is the inverse the bond returns
    returns = Returns(window_length=60, mask=mask)

    basic_metals_down = returns[context.DBB] < -.07
    industrial_sector_down = returns[context.XLI] < -.07
    short_term_bond_down = returns[context.BIL] < -.01
    cost_of_debt_up = short_term_bond_down
    dollar_up = returns[context.UUP] > .07

    # Bear signal if any one of the above is triggered
    bear_signal = (basic_metals_down |
                   industrial_sector_down |
                   cost_of_debt_up |
                   dollar_up
                   )
    days_since_last_bear_signal = Days_Since_True([bear_signal],
mask=mask)

    # Go out of the market if bear in recent days
    go_out_of_the_market = days_since_last_bear_signal <
context.SUSPEND_DAYS
```

Create bear signal base on 90 day return from selected ETF signal

Check whether any of the bear signal is triggered

Execute "Out" if any bear signal triggers within 14 trading days, otherwise, long the SPY

Appendix 2 (Downturn forecast)

DBB (metals) signals out of market precisely during market crush in Q3 2008 and Q1 2009