Mean Reversion Basics (State)

Introduction

In the first chapter of this study we tried to determine whether mean reversion forces have been consistently present in the US stock market over the past 50 years. In the second and third chapters, we looked at whether the *size* and/or the *persistence* of directional movement in the S&P500, up or down, have historically affected the likelihood of mean reversion the following day.

In this chapter we will look at how different current market *states* - both short-term and long-term - impact the tendency of prices to revert to the mean.

For the sake of the analysis, we will focus on reversions occurring after at least 3 consecutive up days or at least 3 consecutive down days. In this paper, an overbought short-term state is said to be in place if the 3 day move started when prices were above the 10 day moving average, while an oversold short-term state is in place if the 3 day move started when prices were below the 10 day moving average. Golden Cross and Death Cross conditions (50 DMA above/below 200 DMA) are used to define - respectively - bullish and bearish long-term market states.

Analysis - M-R Long-Side

In this section of the study we look at how - over the past 20 years - bullish or bearish market conditions in the S&P500 affected the tendency of prices to mean-revert upwards after 3 day losing streaks. A 20 year look back period will be used in an effort to keep results in tune with current market conditions.

System data:

- Instrument: INX (S&P500 Index) from Jan 1st 1995 to Dec 31st 2014 (20 years)
- Capital per trade: US$ 1,000,000 (no compounding)

System rules:

- Enter long at the close after a minimum of 3 consecutive down days (varying market states)
- Exit 1 day later

In the first long-side example below we focus on short-term market state. As we can see, irrespective of market condition ("either" row), the market has historically had a 62% probability of "bouncing" after 3 or more days of falling prices. This probability was almost identical during both short-term bullish or bearish conditions (62% vs 61%). The system's profit factor during bearish short-term conditions (1.94), however, was considerably greater than during bullish short-term conditions (1.40).

1-Day Long-Side Mean-Reversion after at least 3 Consecutive Down Days (S&P500: 1995-2014)				
ST Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Decline started > 10 day MA	287	62.37 %	0.83	**1.40**
either	439	61.96 %	0.99	1.63
Decline started < 10 day MA	152	61.18 %	1.23	**1.94**

The results above indicate that the market's natural tendency to mean-revert after a persistent 3 day price decline is fairly unaffected by short-term market state. The *size* of the mean-reversion move, however, is. So while prices won't bounce more often during short-term oversold conditions, they will likely bounce harder. This is highlighted by a win/loss ratio of 1.23 during short-term oversold conditions compared to a ratio of only 0.83 during short-term overbought conditions. These results are intuitive, and suggest that market declines that begin in already oversold conditions are likely to provide better overall contrarian trade expectancy than declines that begin in neutral or overbought conditions.

In the second long-side example we look at long-term market state. As shown in the table below, 3 days of consecutive price drops during long-term bullish periods (Golden Cross) yielded both higher win rates and higher profit factors than 3 day price drops during long-term bearish periods (Death Cross).

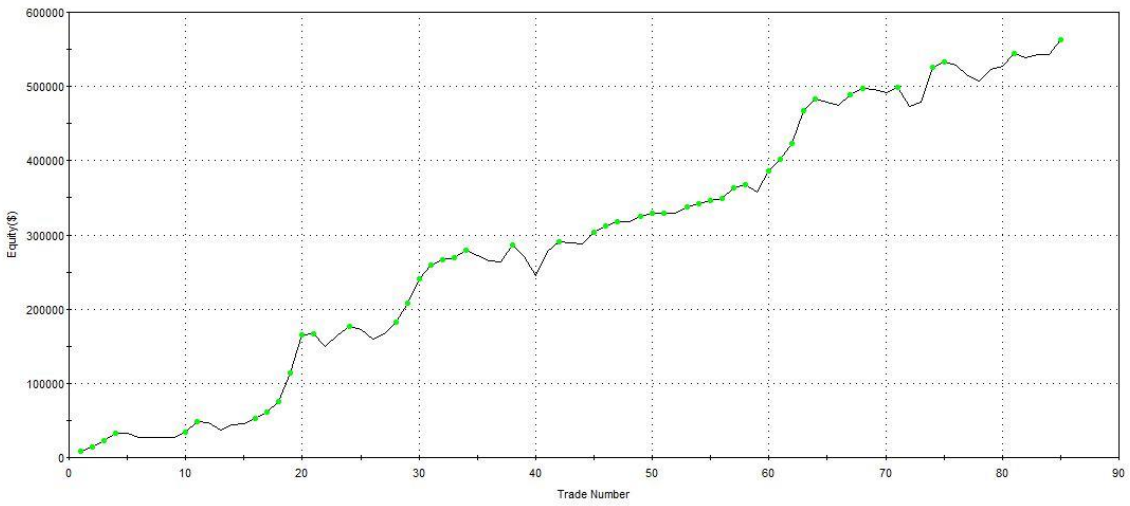
These results are also fairly intuitive. They show that prices have a greater tendency to recover from short-term declines during long-term bullish markets than during long-term bearish markets.

1-Day Long-Side Mean-Reversion after at least 3 Consecutive Down Days (S&P500: 1995-2014)				
LT Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Golden Cross	304	63.82 %	1.01	**1.81**
either	439	61.96 %	0.99	1.63
Death Cross	135	57.78 %	1.04	**1.42**

Given the above it would appear that the ideal time to enter the market for a 1 day opportunistic trade is when the 3 day decline begins in already oversold short-term conditions (below the 10 day MA) but during a bull market (Golden Cross condition).

The equity curve below shows the results of trading this strategy. As we can see, the edge was very strong and consistent throughout the 20 year period. The strategy would have won 2/3 of the time and would have generated almost 4 times more profits than losses.

1-Day Long-Side Mean-Reversion after at least 3 Consecutive Down Days (S&P500: 1995-2014)					
ST Market Condition	LT Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Below 10 day MA	Golden Cross	85	67.06 %	1.91	3.90



Analysis - M-R Short-Side

In this section of the study we look at how - over the past 20 years - bullish or bearish market states in the S&P500 affected the tendency of prices to mean-revert downwards after 3 day winning streaks. As in the long-side study, a 20 year look back period is used in an effort to keep results in tune with current market conditions.

System data:

- Instrument: INX (S&P500 Index) from Jan 1st 1995 to Dec 31st 2014 (20 years)
- Capital per trade: US$ 1,000,000 (no compounding)

System rules:

- Enter short at the close after a minimum of 3 consecutive up days (varying market states)
- Exit 1 day later

In the first short-side example below we again focus on short-term market state. As we can see, historically the market has not had a marked propensity to pull back after 3 days of consecutive price gains ("either" row). In fact the next day had an almost perfect 50/50 probability of closing either up or down. However, short-side mean-reversion forces were noticeably stronger when prices were already relatively overbought (above the 10 day MA), as reflected by the higher win rate, win/loss ratio and profit factor data. So in essence, a speculative 1 day short trade offers the best expectancy if the persistent price pop occurs on the back of pre-existing overbought conditions.

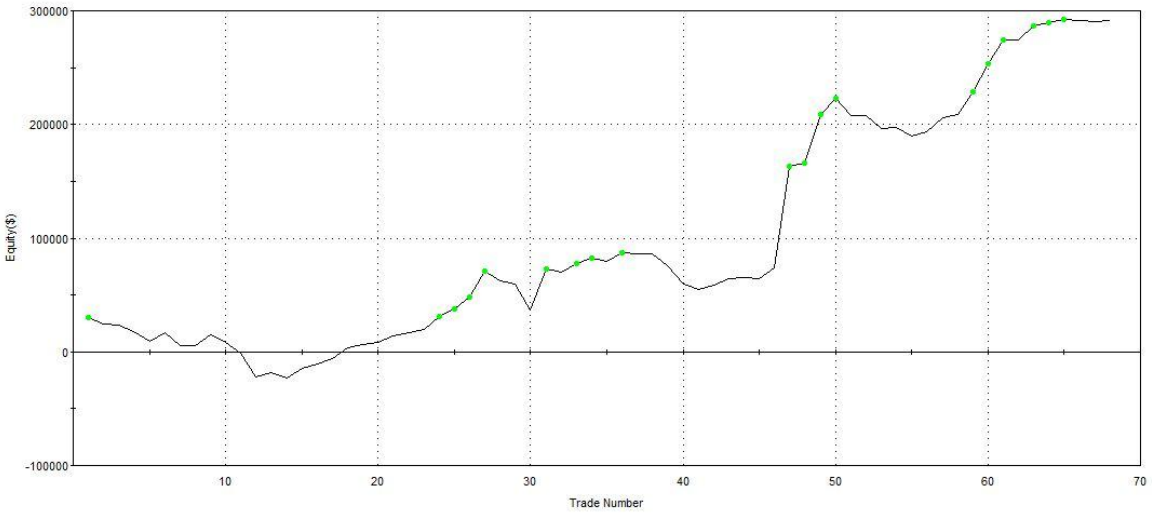
1-Day Short-Side Mean-Reversion after at least 3 Consecutive Up Days (S&P500: 1995-2014)				
ST Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Rise started > 10 day MA	408	54.41 %	1.15	**1.38**
either	729	52.00 %	1.08	1.17
Rise started < 10 day MA	321	48.91 %	1.04	**1.00**

In the second short-side example below we look at long-term market states and filter based on the presence of a Golden Cross or Death Cross condition. As we can see, the results for the two long-term market states are very different. Systematically taking a contrarian 1 day short position after a 3 day market pop during long-term bullish periods would have been a losing strategy over the past 20 years (profit factor of 0.91). The same strategy during long-term bearish markets, however, would have been profitable, as shown by the profit factor of 1.87.

1-Day Short-Side Mean-Reversion after at least 3 Consecutive Up Days (S&P500: 1995-2014)				
LT Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Golden Cross	582	50.34 %	0.90	**0.91**
either	729	52.00 %	1.08	1.17
Death Cross	147	58.50 %	1.32	**1.87**

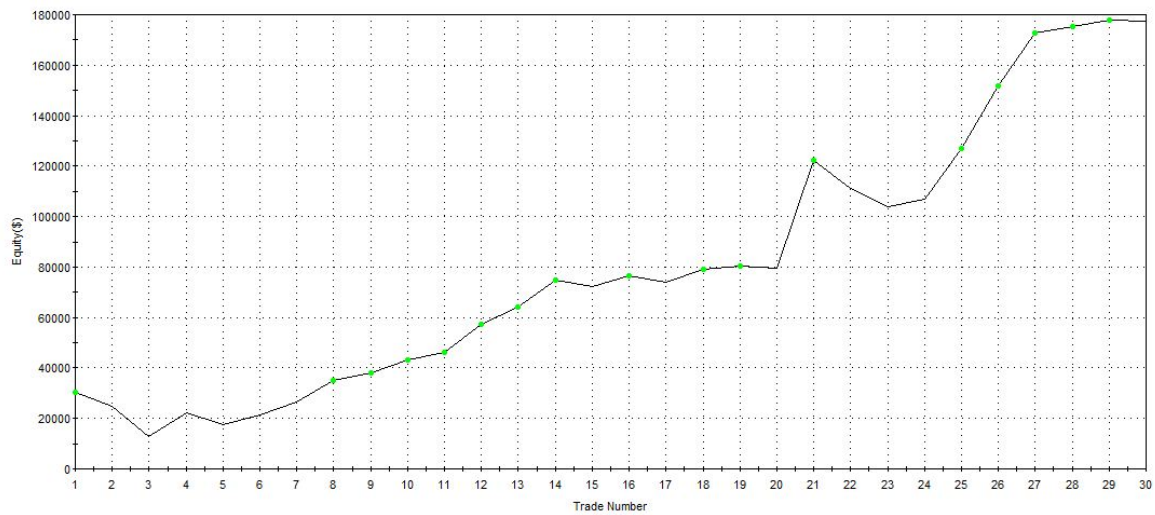
So, to summarize, 1 day short positions are best taken when the market is short-term overbought and during long-term bearish conditions (Death Cross). The chart below shows the results of trading this strategy.

1-Day Short-Side Mean-Reversion after at least 3 Consecutive Up Days (S&P500: 1995-2014)					
ST Market Condition	LT Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
> 10 day MA	Golden Cross	68	61.76 %	1.62	2.61



The trading statistics indicate that this would have been a winning strategy over the past 20 years. The system would have been profitable 62% of the time and would have generated 2.6 times more profits than losses. The equity curve, however, is choppy and characterized by fairly long strings of consecutive losing trades. This is because our example strategy uses the "at least 3 consecutive up days" condition, meaning that back-to-back trades were taken after 3, 4, 5 and more consecutive up days. This is an issue as the market is known for periods of irrational bullishness with large number of consecutive up days. Using the more conservative "exactly 3 consecutive up days" condition yields the results shown below. The equity curve is straighter, the win rate rises to 70% and the profit factor to 4.78, albeit at the cost of a greatly reduced trade count.

1-Day Short-Side Mean-Reversion after EXACTLY 3 Consecutive Up Days (S&P500: 1995-2014)					
ST Market Condition	LT Market Condition	Trades	Win Rate	Win/Loss Ratio	Profit Factor
> 10 day MA	Golden Cross	30	70.00 %	2.05	4.78



Summary

The key findings are:

- Mean-reversion after at least 3 consecutive down days appears to provide a solid 1 day contrarian edge irrespective of short-term market state. Short-term oversold conditions, however, offer better overall profitability as prices tend to bounce "harder" in oversold markets than in neutral or overbought markets.
- Long-side mean-reversion after at least 3 consecutive down days is also affected by long-term market state. Jumping into a price pullback during a bull market provides better 1 day expectancy than doing so during a bear market.
- Results for the short-term mean-reversion studies were also affected by the state of the short-term market. Going short after a 3 day pop when the market was already short-term overbought would have been a better strategy than going short when the market was short-term neutral or oversold.
- Similarly, going short after a 3 day pop would have been considerably more profitable during a long-term bearish market (Death Cross) than during a long-term bullish markets (Golden Cross).
- So, while "*the trend is your friend*" is indeed true when it comes to long-term market condition, "*what goes up must come down*" (and vice versa) is a more appropriate adage when it comes to short-market condition. It therefore best to go long after persistent price drops in oversold conditions during a long-term bull market, and to go short after persistent price pops in overbought conditions during a long-term bear markets.