



Mean Reversion Basics (Persistence)

Introduction

In the introductory chapter of this paper we looked at whether mean reversion forces have been consistently present in the US stock market over the past 50 years. In the second chapter, we tried to determine whether the relative size of a daily price movement in the S&P500, up or down, affects the likelihood of prices reverting back towards the mean the following day.

In this paper, we will look at whether the *persistent* nature of a deviation from average prices impacts their tendency to revert to the mean.

Analysis - M-R Long-Side

In this first study we test whether - over the past 20 years - an increasing number of consecutive down days in the S&P500 affected the likelihood of the following day being another down day (momentum) or an up day (reversion). A 20 year look back period is used here instead of a 50 year period to keep results in tune with more current market conditions. We will disregard both market *state* (long and short-term trend) as well as the actual *size* of the price drop and simply focus on the *persistent* nature of the directional move.

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)

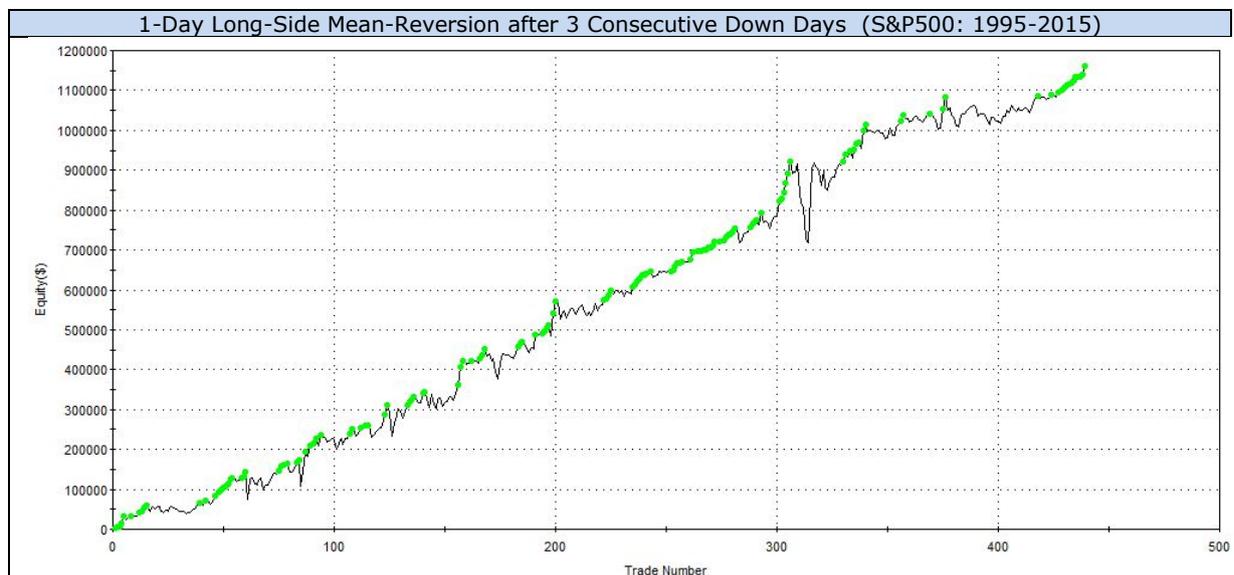
System rules:

- Go long at the close of a down day (after a minimum number of consecutive down days)
- Exit 1 day later

Results are shown in the table below:

1-Day Long-Side Mean-Reversion (S&P500: 1995-2015)				
Consecutive Down Days	Trades	Win Rate	Win/Loss Ratio	Profit Factor
1 or more	2307	55.79 %	0.93	1.18
2 or more	1014	56.41 %	0.98	1.27
3 or more	439	61.96 %	0.99	1.63
4 or more	165	64.24 %	1.01	1.82
5 or more	59	71.19 %	1.20	2.97

As we can see, the greater the number of consecutive down days, the greater the likelihood of a bounce in prices the next day. This likelihood, as measured by the win rate, rises steadily from 55.8% (1 down day or more) all the way to 71.2% (5 down days or more). Trade expectancy, as measured by the profit factor data, also rises in a linear manner. So stepping into a market that has seen several consecutive price drops has historically yielded a better 1 day trade outcome than doing so after just one or two days of declining prices. Below is a chart showing the system's equity curve using a 3 or more consecutive down day input. As we can see, the edge is fairly strong and consistent throughout the full 1995-2015 period.





In this next test, we look at instances when a large daily fall in prices, in this example a 2% or greater drop, was preceded by either an up day or a down day. The table below shows the results:

1-Day Long-Side Mean-Reversion after a 2% or greater price drop (S&P500: 1995-2015)				
Preceded by:	Trades	Win Rate	Win/Loss Ratio	Profit Factor
An up day	105	56.19 %	0.75	0.96
Either	216	60.19 %	0.96	1.45
A down day	111	63.96 %	1.19	2.12

The results here are truly compelling. Large daily drops that were preceded by an up day showed a negative 1 day trade expectancy, with a profit factor of just 0.96. Large daily drops that were preceded by a down day, on the other hand, displayed a much higher likelihood of bouncing the following day and generated a very attractive profit factor of 2.12.

So clearly, "unexpected" (or counter-trend) price drops tend to dissuade traders from stepping into the market. However, continuation-type moves - i.e. large price drops that are consistent with recent market sentiment - tend to attract dip-buyers potentially looking for oversold entry opportunities.

Analysis - M-R Short-Side

In this short-side study we look at whether - over the past 20 years - the number of consecutive up days in the S&P500 affected the likelihood of the following day being another up day (momentum) or, conversely, a down day (reversion).

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:

- Go short at the close of an up day (after a minimum number of consecutive up days)
- Exit 1 day later

Results are shown below:

1-Day Short-Side Mean-Reversion (S&P500: 1995-2015)				
Consecutive Up Days	Trades	Win Rate	Win/Loss Ratio	Profit Factor
1	2716	47.53 %	1.10	0.99
2	1422	48.73 %	1.10	1.05
3	728	52.06 %	1.08	1.17
4	349	53.58 %	1.21	1.39
5	162	54.94 %	1.00	1.22

The results here are fairly underwhelming. While the system's win rate and profit factor do indeed improve as the number of consecutive up days increase, they do so only moderately. So a rising string of consecutive up days only marginally increases the likelihood of a price correction. Below is a rather choppy equity curve showing the results of the system using 3 consecutive days:





Below we look at the result of shorting large price increases (2% or more) that were preceded by either an up day or a down day:

1-Day Short-Side Mean-Reversion after a 2% or greater price increase (S&P500: 1995-2015)				
Preceded by:	Trades	Win Rate	Win/Loss Ratio	Profit Factor
An up day	84	53.57 %	1.36	1.57
Either	198	48.48 %	1.16	1.09
A down day	114	44.74 %	1.13	0.91

Results here are very similar to those shown in the corresponding long-side study. Large market pops that followed the direction of recent price movements (i.e. preceded by an up day) stood a greater chance of pulling back than pops that were preceded by a down day.

The same logic seems to apply here: persistent, continuation-type moves tend to attract contrarian traders willing to bet against the market. Counter-trend or random market moves leave most traders perplexed and unwilling to take a speculative position, either way.

Summary

The key findings are:

- Game play theory states that the expected outcome of any one event is not affected by the known outcome of prior events. So at the roulette table, even after a series of 5 consecutive reds, the likelihood of the ball landing on the black is still 50/50. The efficient market hypothesis would tend to suggest that this concept would also apply to stock market series, but this is clearly *not* the case. In the US stock market, a string of consecutive up or down days directly affects the directional bias of the day that follows. This is particularly true when the most recent price movement has been large (an "exhaustion" move).
- Long-side mean reversion is the most affected by the presence of a persistent directional move. Both the likelihood and the trade expectancy of a price bounce is directly correlated to the number of down days that preceded the most recent drop.
- Short-side mean reversion is also impacted by the persistence of the directional move, but to a much lesser extent. An increasing number of consecutive up days does increase the likelihood of a pullback the subsequent day, but the edge is small and likely not tradable without using additional conditional filters, such as those related to size and state.