



Mean Reversion Basics (Size)

Introduction

In the introductory chapter of this study we looked to determine whether mean reversion forces have been consistently present in the US stock market over the past 50 years. We studied both *long-side* mean reversion (buying oversold conditions) and *short-side* mean reversion (shorting overbought conditions).

In this chapter we will look at whether the *size* of a day's price movement in the S&P500, up or down, affects the likelihood of prices moving back towards the mean the following day. We will disregard whether the price change follows a series of similar directional moves (*persistence*) or whether the market already finds itself in either a short-term or long-term overbought/oversold condition (*state*). These variables will be reviewed in detail in other chapters of this study.

Analysis - M-R Long-Side

In this first study we test whether - over the past 20 years - the size of a one day drop 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 favoured here over a 50 year period in an effort to keep results in tune with current market conditions. We will disregard both market *state* and the *persistence* of the directional move and simply focus on the *size* of the one day price change.

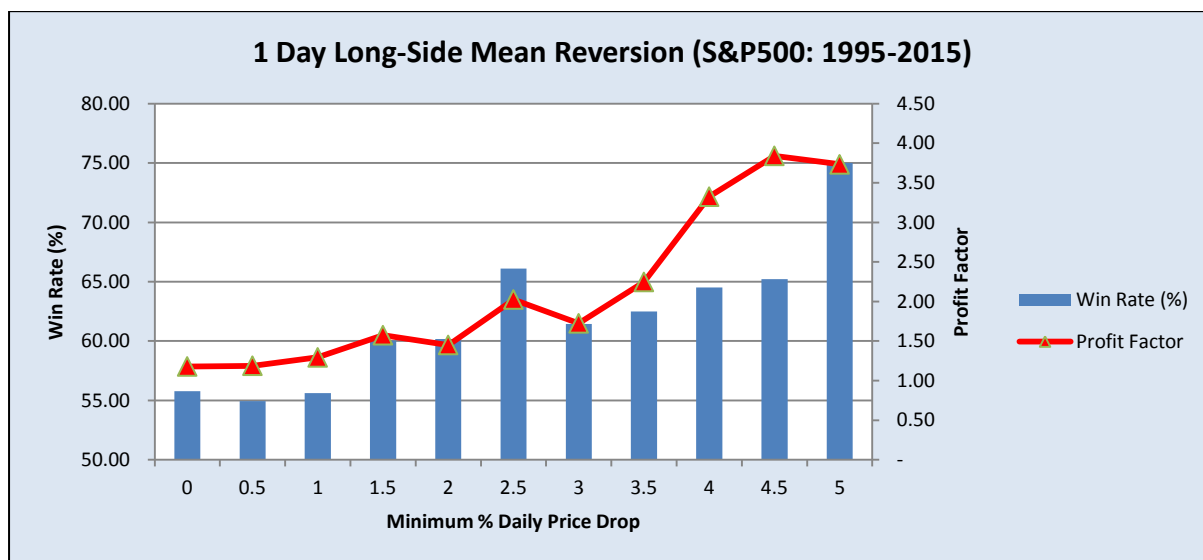
System data:

- 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 % drop)
- Exit 1 day later

Results are shown below:



1-Day Long-Side Mean-Reversion (S&P500: 1995-2015)				
Minimum Daily Drop	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Any size	2307	55.79 %	0.93	1.18
0.5 %	1267	54.93 %	0.97	1.19
1.0 %	696	55.60 %	1.03	1.29
1.5 %	398	60.05 %	1.05	1.57
2.0 %	216	60.19 %	0.96	1.45
2.5 %	118	66.10 %	1.04	2.03
3.0 %	70	61.43 %	1.08	1.72
3.5 %	40	62.50 %	1.35	2.25
4.0 %	31	64.52 %	1.83	3.32
4.5 %	23	65.22 %	2.05	3.84
5.0 %	16	75.00 %	1.24	3.73



The results show that, over the past 20 years, a down day had on average a 56% chance of being followed by an up day. This in itself tends to confirm the market's tendency to revert, or "bounce", after a price drop, big or small. However, the average win to average loss ratio of 0.93 indicates that when momentum moves did occur (i.e. further price drops the following day) these were typically greater in size than the reversion moves (the bounces). The net result in a fairly unimpressive profit factor of only 1.18 over all trades.

However, as we filter for larger minimum daily price drops, we notice that the statistics improve in an almost linear manner, as shown in the chart above. At >1.5% one day drop, the win rate rises to 60%, at 2.5% it rises to over 65%, and at 5% it hits 75%. The average win to average loss ratio also improves, albeit more slowly. This results in some fairly attractive trade expectancy figures when the minimum daily price drop is 1.5% or greater.

It should be noted that filtering for large moves greatly reduces the number of trades, potentially giving extreme outliers too much weight and hence skewing statistical results. It is therefore essential to always refer to the corresponding equity curve to search for visual confirmation of the perceived statistical bias.

Analysis - M-R Short-Side

In this second study we look at whether - over the past 20 years - the size of an up day in the S&P500 affected the likelihood of the following day being an up day (momentum) or, conversely, a down day (reversion). Like in the previous study, we will use yesterday's close as the simplest expression of "mean price" to test the presence of mean reversion forces.

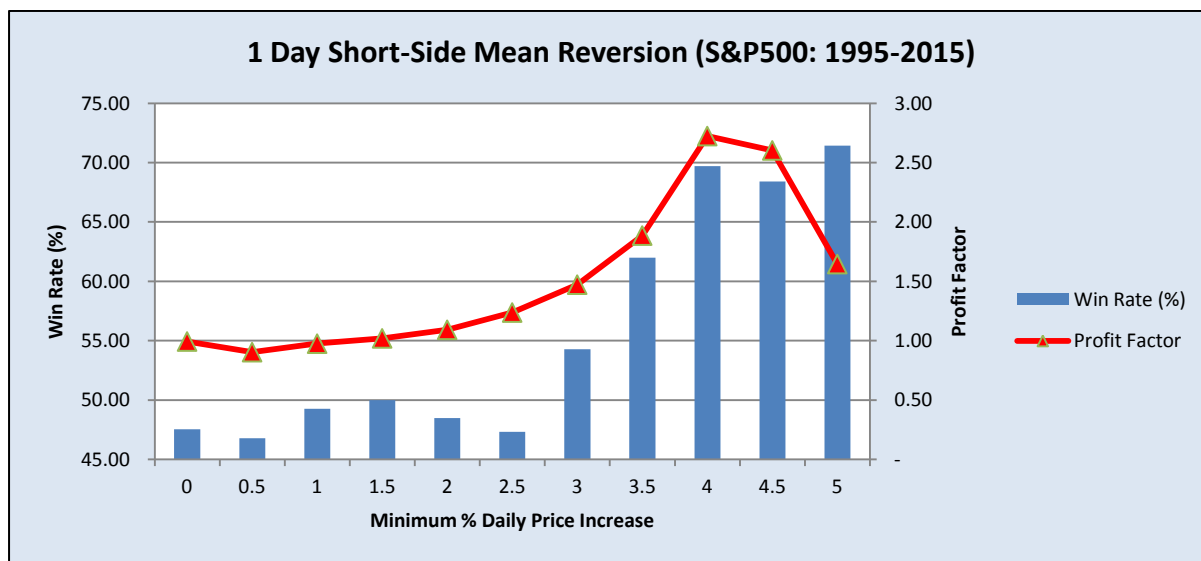
System data:

- 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 % rise)
- Exit 1 day later

Results are shown below:



1-Day Short-Side Mean-Reversion (S&P500: 1995-2015)				
Minimum Daily Pop	Trades	Win Rate	Win/Loss Ratio	Profit Factor
Any size	2716	47.53 %	1.10	0.99
0.5 %	1477	46.78 %	1.03	0.90
1.0 %	737	49.25 %	1.00	0.98
1.5 %	370	50.00 %	1.02	1.02
2.0 %	198	48.48 %	1.16	1.09
2.5 %	112	47.32 %	1.38	1.24
3.0 %	70	54.29 %	1.24	1.47
3.5 %	50	62.00 %	1.16	1.89
4.0 %	33	69.70 %	1.18	2.72
4.5 %	19	68.42 %	1.20	2.60
5.0 %	14	71.43 %	0.66	1.65



The chart and table above show that, over the past 20 years, up days of any size were followed by down days only 47.5% of the time. The average size of the reversion moves that followed were marginally greater than the momentum moves, resulting in an almost perfectly neutral profit factor of 0.99.

When we filter for larger minimum daily price pops, however, we again notice a slow and progressive improvement in trade statistics. But unlike the long study, win rates and profit factor figures only start improving noticeably at fairly extreme minimum delta levels of 3% or above. Note that the perceived dip in results for pop levels of 4% and above are due to a single huge outlier, dated Nov 2008.

The study suggests that "single day" short-side mean-reversion does indeed exist in the US stock market, but that short-side mean-reversion becomes a strong and potentially tradable market force only when prices have increased substantially the previous day.

Summary

The key findings are:

- The inflationary nature of US stock market prices means that - over an average trading year - the total number of up days tends to be slightly greater than the total number of down days. This inherent long bias alone helps feed the market's tendency to mean-revert after a down day. Moreover, we notice that the larger the previous day's price drop, the greater the likelihood of an upward pop in prices (win rate) the following day. This, coupled with an increasing win/loss ratio, can generate some interesting trade expectancy (profit factor) figures when betting on the long side after a sizeable 1 day market drop.
- The main driver behind long-side mean-reversion is investor psychology. Everyone likes a bargain, so falling prices tend to attract speculation from dip traders and interest from longer-term investors looking to get long at lower prices. And the bigger the perceived bargain, the greater the interest. Short sellers are also motivated to take profits after a fall in prices by buying the market to cover their position, thereby helping push prices back up.
- Recognizing and potentially exploiting short-side mean-reversion opportunities is a considerably more complex exercise. Indeed, while a down day has a positive likelihood of being followed by an up day (55.8%), an up day has a slightly *negative* likelihood of being followed by a down day (47.5%). So, simply said, falling prices tend to favour reversion, while rising prices tend to favour momentum. However, when daily price increases become extreme, the market's tendency towards bullish momentum finds itself pivoting towards mean-reversion.
- Short-side reversion is also predominantly fueled by investor psychology. Speculators and investors typically welcome slowly rising prices and will hold on to their positions hoping for a continued market run. Only after *unusually* large 1 day price increases will traders lose optimism in further short-term price gains and look to take profits. These are also the levels at which short-term speculators will step in and gamble on the short-side, further driving prices downwards.