

# ***Compounding Effects in Inverse and Leveraged Funds***

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## ***Introduction***

Inverse and leveraged funds have come under considerable scrutiny in recent months because the cumulative returns generated by these funds have not matched the expectations of many investors. Over the twelve month period through the end of July of 2008, the S&P500 returned -19.9%. The *ProShares* S&P500 Inverse Fund (SH) returned 2.1% over this period. Does this mis-match in one-year returns mean that something is wrong with these funds? In this article, we demonstrate that the potential for under-performance is a direct consequence of the combination in volatility and daily compounding. Leveraged funds amplify these effects because they amplify volatility.

The analysis presented here demonstrates that inverse funds do provide their intended function over limited periods of time. Inverse funds are designed to allow the investor to take a position based upon the view that an underlying index will decline. The amount of time that an investor can effectively hold these types of funds depends upon the investor's confidence in the directional view and the volatility of the underlying index.

An un-leveraged inverse fund is designed to return the negative of the daily return of the underlying index. These funds are, in general, quite effective in this regard. As we will demonstrate, however, the long-term mismatch in cumulative returns is not caused by the daily tracking error (i.e. difference in daily returns).

On a daily basis, SH has returned something very close to the negative of the S&P500. The naive expectation might be that in a 12-month period in which the S&P500 returns -19.9% then SH will return +19.9%. SH actually returned 2.1% over this one-year period. How is this possible? To demonstrate how compounding and leverage work together to create tracking error, consider the following example of returns over a ten-day period:

Day	Daily Return			
	Index Return	Inverse	2X	Inverse 2X
0				
1	-5%	5%	-10%	10%
2	-5%	5%	-10%	10%
3	-5%	5%	-10%	10%
4	-5%	5%	-10%	10%
5	-5%	5%	-10%	10%
6	-5%	5%	-10%	10%
7	-5%	5%	-10%	10%
8	10%	-10%	20%	-20%
9	10%	-10%	20%	-20%
10	10%	-10%	20%	-20%

Table 1

The first column shows returns for the index (such as the S&P500). The second column shows the daily return for an **Inverse fund** – so the return for each day is exactly equal and opposite the returns for the index. The **2X fund** is designed to double the daily return of the index and the **Inverse 2X** fund is designed to return twice the negative of the return for the index. In this case, we are ignoring fees and expenses. On Day 1, the **Index** returns -5% so the **Inverse** returns 5%, the **2X** returns -10% and the **Inverse 2X** returns 10%.

If we track the value of \$1 invested in each of these strategies, how do we come out after ten days? The results are shown below:

Day	Value of \$1 Invested			
	Index Return	Inverse	2X	Inverse 2X
0	1	1	1	1
1	0.95	1.05	0.90	1.10
2	0.90	1.10	0.81	1.21
3	0.86	1.16	0.73	1.33
4	0.81	1.22	0.66	1.46
5	0.77	1.28	0.59	1.61
6	0.74	1.34	0.53	1.77
7	0.70	1.41	0.48	1.95
8	0.77	1.27	0.57	1.56
9	0.84	1.14	0.69	1.25
10	0.93	1.03	0.83	1.00
Cumulative Return	-7.1%	2.6%	-17.4%	-0.2%

Table 2

The Index has dropped by a cumulative 7.1%. The Inverse fund, however, is only up by 2.6%-- despite having exactly the opposite return of the **Index** each day. The 2X fund has lost 17.4% rather than the -14.2% ( $2 \times 7.1\%$ ) that would be twice the cumulative return for Index. What is perhaps most striking is that the **2X Inverse** strategy has actually lost a small amount, with a cumulative return of -0.2%. It is important to fully grasp the meaning of this result. An investor who was certain that the market would lose money over this ten day period would have been correct—the **Index** declined by a cumulative 7.5%. This investor, being highly confident of his/her position might have chosen to purchase a leveraged inverse fund (in the form of the 2X Inverse) and he/she could have lost money on this bet—despite being correct on the market's direction.

This simple example is, of course, an exaggeration of typical market outcomes. Successive days of -5% losses or 10% gains are not typical. In real markets, this level of disparity in cumulative returns will tend to take longer to manifest itself because the magnitude of daily swings is smaller. This example should make it clear, however, that inverse and/or leveraged strategies have a high probability of exhibiting compounding effects such that the cumulative return of an inverse strategy over a significant number of days is not likely to be equal to -1 time the cumulative return on the index. Leverage amplifies these effects.

It should be noted that compounding can work for or against the investor (in regards to initial expectations). Table 2 provides an example of when compounding is unfavorable. The cumulative return of the Index is -7.1%; we would initially expect an inverse fund to yield +7.1%, but it falls short and returns only 2.6%. The following tables highlight when compounding works for the investor.

Day	Daily Return			
	Index Return	Inverse	2X	Inverse 2X
0				
1	10%	-10%	20%	-20%
2	10%	-10%	20%	-20%
3	10%	-10%	20%	-20%
4	10%	-10%	20%	-20%
5	10%	-10%	20%	-20%
6	10%	-10%	20%	-20%
7	10%	-10%	20%	-20%
8	-5%	5%	-10%	10%
9	-5%	5%	-10%	10%
10	-5%	5%	-10%	10%

Table 3

Day	Value of \$1 Invested			
	Index Return	Inverse	2X	Inverse 2X
0	1	1	1	1
1	1.10	0.90	1.20	0.80
2	1.21	0.81	1.44	0.64
3	1.33	0.73	1.73	0.51
4	1.46	0.66	2.07	0.41
5	1.61	0.59	2.49	0.33
6	1.77	0.53	2.99	0.26
7	1.95	0.48	3.58	0.21
8	1.85	0.50	3.22	0.23
9	1.76	0.53	2.90	0.25
10	1.67	0.55	2.61	0.28
Cumulative Return	67.1%	-44.6%	161.2%	-72.1%

Table 4

As we can see, all funds exceed their expectations. The Inverse Funds do not perform as poorly as they “should have” (e.g. actual: -44.6% vs. expected -67.1%), and the Leveraged Fund returns far more than what an investor would expect.

### What to Know

- Leveraged and Inverse Funds do what they are designed to do (i.e. track a multiple of daily benchmark returns), but investors may feel cheated if they do not properly understand the net effects of returns over a given investment period. The more volatile the market, the more likely that cumulative returns will not match the multiple of the benchmark cumulative returns.

- An investor's intuition of the market can be correct (e.g. negative return), but they may not see the return as expected by their bet.

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