WINTON

Research Brief

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The dead cat bounce: price rebounds and caps on trend following

Whether driven by trading algorithms, liquidity issues or simple panic, many market participants buy as the price surges or sell during market crashes, rushing together for the exit. A simple trend-following system shares this behaviour, but setting limits on daily trading curtails the response to large price movements. Do these limits damage profits? It seems that over the long term, they have not. The reason can be found in a property that is shared across a broad range of financial markets and across timescales: large price movements are often followed by a small rebound. In the pitiless jargon of financial markets, there is a 'dead cat bounce'. For this reason, limiting the rush for the exit may benefit profits as well as reduce systemic risk.

Trend following and large price movements

Trend followers tend to make large trades after large price movements, because these movements change estimates of trend strength. For example, a price movement against an existing trend may cause a trend-follower to reduce or reverse its position. If a fund trades a large part of its position in a single day, it may form a significant fraction of the daily volume. This leads to increased trading costs. One way to avoid this is to impose a cap to limit the size of trades.

We might ask whether profits are limited by these caps. Do they stop a trend follower from latching on to a trend quickly as it appears, or from removing capital as the trend disappears?

Figure 1 shows four recent examples of large price changes in futures markets. Each event was large enough to change an estimate of the market's trend over the preceding weeks or months. The bottom chart is a clear example. On 15 March we would have noticed a clear downwards trend over the last few weeks, but after that date we might have estimated the trend as close to zero. Each of these four events was followed by a small rebound over the next few days. In these cases, funds that immediately changed their positions to follow a changing trend would have lost out compared to those who did not respond or traded more slowly. If this pattern is common, we would expect a capped trend follower to outperform an uncapped one in the long term. In this brief, we look at these rebounds using a large sample of historical data.

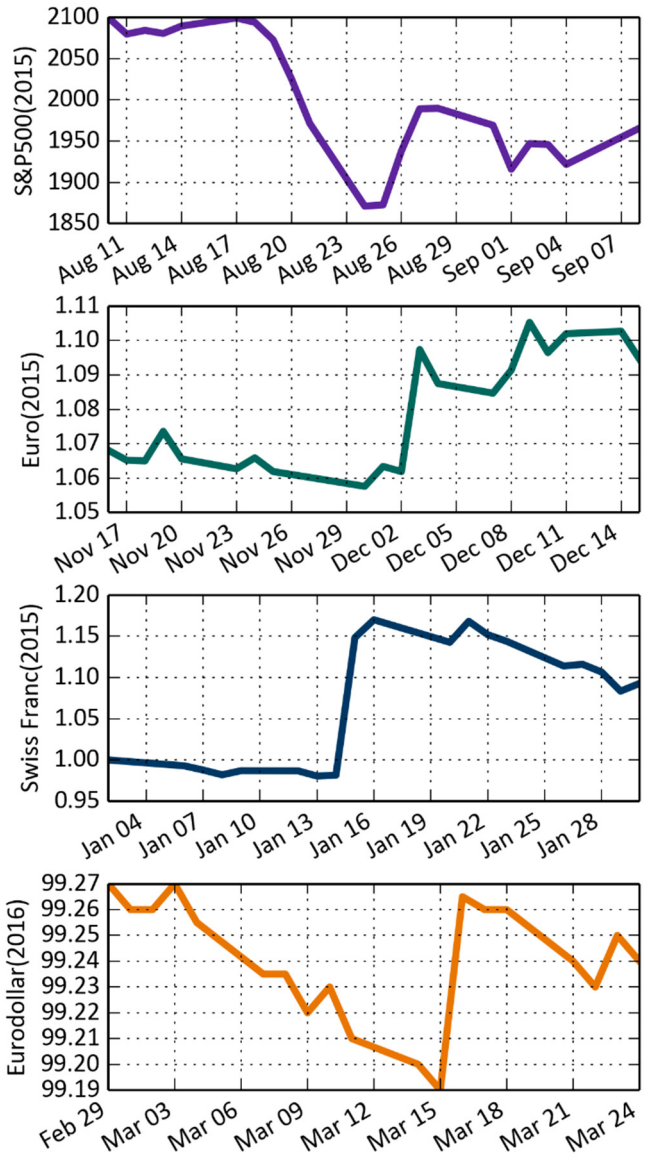

Figure 1: Examples of recent large movements in futures markets. They are the S&P 500 in August 2015, the euro/dollar exchange rate after the ECB anouncement in December 2015, the removal of the Swiss franc's peg to the euro in January 2015, and the Federal Reserve announcement in March 2016.

Predatory trading, liquidity spirals and panic

A rebound does not occur after every large price movement, but there are reasons to expect it. 'Predatory traders' try to anticipate trades and profit from them[1]. This may cause temporary price impact and overshooting. Liquidity spirals, where investors sell because they can no longer fund their positions as the price falls, may also lead to temporary price movements[2]. Systematic traders, including trend followers and risk parity funds, may have a similar effect[3].

The combined effect of all these mechanisms, together with old-fashioned panic as worried investors exit the market, can lead to a violent crash followed by a recovery when the panic is over. Some of these mechanisms apply more strongly to crashes than to positive price movements (although the possibility of shorting means that panic and liquidity spirals can operate in market surges as well as in crashes). We therefore expect rebounds to be stronger after crashes than after surges.

Price rebounds: the data

Because large price movements are rare, we need many years of data to see patterns. We take the hundred largest futures markets and examine the aftermath of all daily price movements larger than five times the previously estimated volatility. To view crashes and surges on the same diagram, the scale is reversed for negative price movements (crashes).

Figure 2 shows that in the historical data[4], there is a weak tendency for large price movements to be followed by rebounds rather than by a continued trend. The tendency is stronger for downward price movements than for

[1] Brunnermeier and Pedersen, *J.Finance* 60, 1825-1863 (2005).
[2] Pedersen: 'When everyone runs for the exit'. NBER working paper 15297 (2009).
[3] Winton working paper 'Systematic trading and systemic risk' (2016).
[4] We use back-adjusted returns for futures markets. That is, we assume that the investor maintains a position in the contract closest to expiry, 'rolling' into the next contract as the expiry date approaches. Similarly, returns for equities (Figure 4) are total returns, taking into account gains and losses from such events as dividends and splits. In some financial futures markets where we believe that the method gives reliable results, we extended the time series backwards in time by synthesizing futures prices using data from the underlying spot market. The conclusions are not materially changed by this added data.

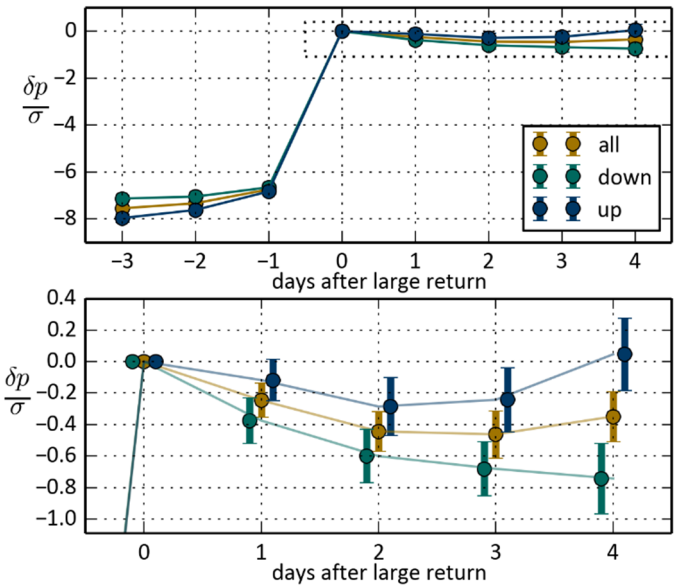

Figure 2: Returns after large daily price changes in futures. The lower chart is an enlarged version of the rectangle shown in the upper chart. Points are displaced horizontally by a small amount in the lower chart to make them visible. Across 100 markets, we selected days where the price change was more than five times the preceding volatility σ (calculated using a 33-day exponentially-weighted moving average (EWMA)). The diagram shows the average cumulative return in units of σ. The signs of returns for price drops are reversed. Error bars show the standard error of the mean, estimated by resampling (bootstrapping).

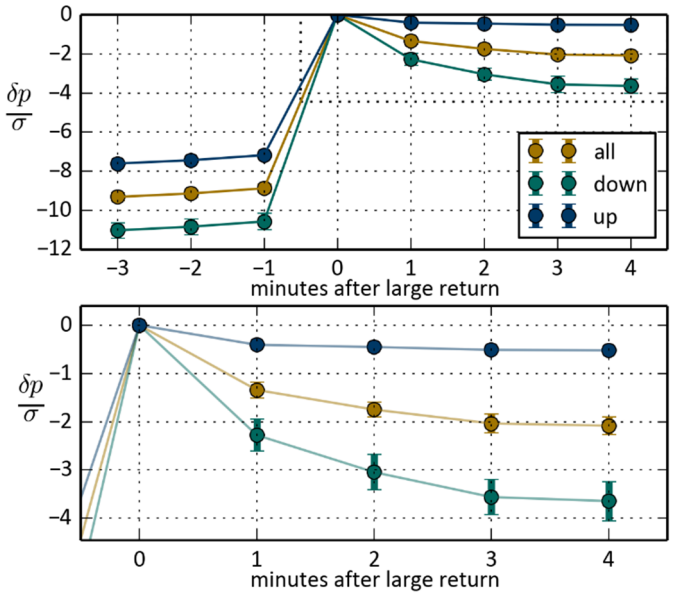

Figure 3: Returns after large one-minute price changes in futures. This figure shows the same analysis as in Figure 2, using one-minute returns rather than daily ones, over the year to 1 May 2016. The volatility is a 33-minute EWMA.

upward ones; the recovery from a crash has tended to be stronger than the downturn after a surge.[5]

Rebounds across timescales and markets

To gain more insight, we can look at other timescales and markets. The presence of trends across a broad range of timescales gives us more confidence in trend following as a trading strategy. Does the rebound also occur on a range of timescales? Figure 3 shows minute-by-minute data for the same set of markets. We see the same pattern: on average, there is a rebound, and the rebound is stronger after crashes than after surges. The same pattern is visible in hourly data.

We can also look at equity markets (Figure 4). We see an effect much stronger than the one for futures. More than 60 research papers have been published on this phenomenon in equities[6]. The effect is so significant that it suggests buying stocks that have suffered large price drops, and selling those that have made large gains. Despite the strength of the effect, this strategy may fail because of the high trading costs during volatile periods and because it is not always possible to trade at the daily close price.

To trade or not to trade?

The rebounds we see in futures prices are much smaller than those in equities, but we are asking a different question. We are not constructing a

[5] We might suspect that rebounds from surges are less severe than those from crashes because of the general upward trend in prices: but the mean daily Sharpe ratio across these markets is only 0.03 (and no market has a ratio greater than 0.09). We would therefore expect the upward trend to produce a difference between 'up' and 'down' of only 0.03 on the scale of the diagram after one day, compared with the measured difference of approximately 0.3.

[6] Amini, Int. Rev. Fin. Anal. 26, 1-17 (2013).

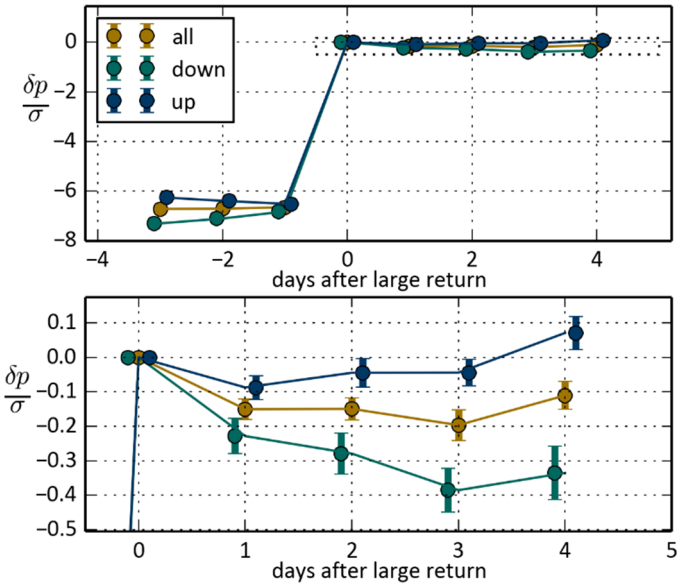

Figure 4: Returns after large daily price changes in equities. This figure shows the same analysis as in Figure 2, using all stocks in the S&P 500 and data since 1960.

trading strategy to profit from these rebounds. Instead, we ask whether there is evidence for the opposite effect: continued trends after large price movements. We need this evidence to justify the large trades an uncapped trend following system makes. These are trades that we are reluctant to make, because they are costly for two reasons: they are large and they are made when the market is volatile.

When the question is posed in this way, the answer is clear. The evidence is not strong at all: in fact, it points against trading to follow large moves. We should consider limiting our participation in these dashes for the exit.

Trading caps

The simplest method to curb these extreme trades is to impose a limit, or 'cap' on the number of lots traded in a single day. This simple rule allows the possibility of exploitation. When the market makes a large movement, the fund will trade a number of lots equal to its cap for several days in a row until it reaches its target position. Other market participants are likely to notice this predictable behaviour and profit from it. Winton uses a number of measures of market activity and expected trading costs to decide when and how to trade, making our behaviour less predictable. But in this brief we will use a simple trade cap as an example of how trading limits affect performance.

A back-test of trading caps

To gauge the effects of trading caps on trend following, we again used historical daily returns for 100 futures markets. For each market, we imposed a simple trade cap which limits trading in a single day to 40% of the average position size over the last 100 days. This has a stronger effect on fast trend-following systems than on slow ones, because the fast systems trade a larger fraction of their position each day.

We ran three trend-following speeds: slow, medium and fast, with holding periods of approximately two weeks, six weeks, and four months. For each market and speed, the system was designed to target an annual volatility of returns set at $10 million[7]. The cap affected the position on 1% of days for the slow system, 2% for the medium system, and 4% for the fast system. We made no attempt to allow for trading costs.

Figures 5 and 6 show two examples of how the capped and uncapped systems differ. In Figure 5, we can see how trend followers might have reacted to a large change in UK interest rate futures in May 2010. In this case, the capped system performed better. Figure 6 shows the most extreme case where the cap damaged performance. On 19 October 1987 ('Black Monday'), the stock market in Hong Kong crashed, along with many other markets around the world. Trading in Hang Seng index futures was suspended for four days. The uncapped system was able to reduce its position more than the capped one before trading was suspended, and therefore suffered a smaller loss from the decrease in the index over these four days.

[7] Since the trade cap is defined as a fraction of the preceding average position, this choice does not affect the results except as a scaling factor. We chose it to be large enough so that the size of a single lot is unimportant.

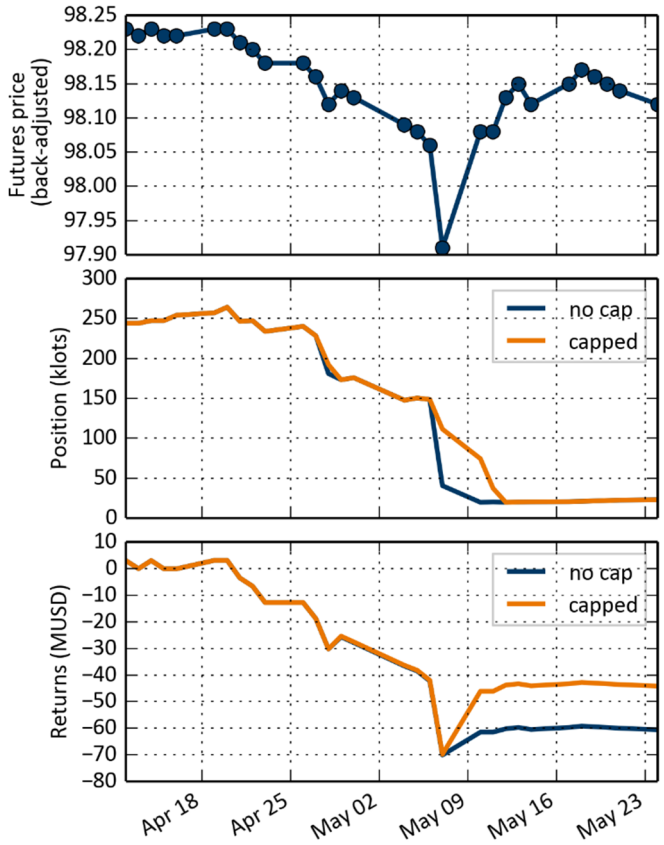

Figure 5: Performance of capped and uncapped slow trend following on sterling LIBOR futures around May 2010. This was a volatile period, with a UK election followed by coalition negotiations and accompanied by the 'flash crash' in the US and the Greek debt crisis. A capped system reduced participation in the sell-off on 6 May and profited from a rebound.

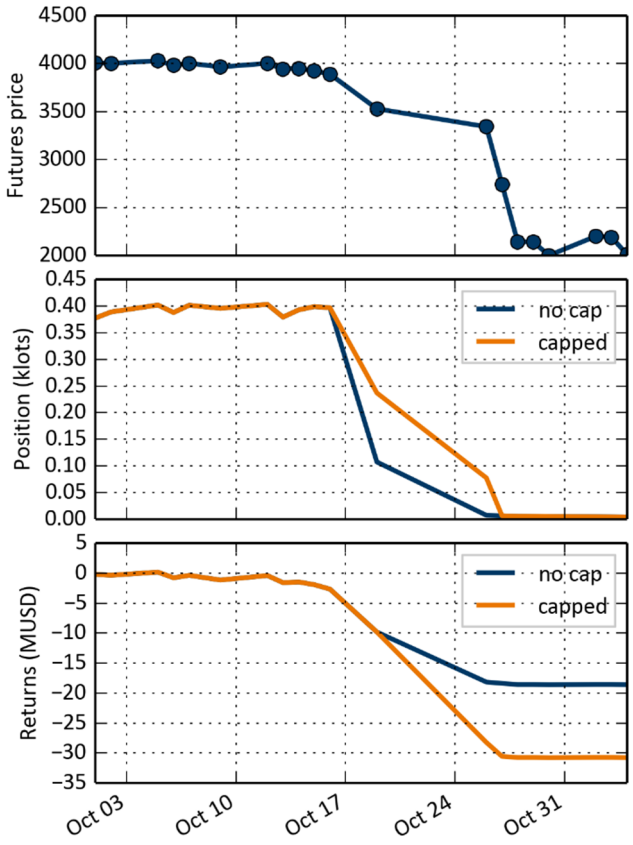

Figure 6: Performance of capped and uncapped medium-speed trend following on Hang Seng index futures around Black Monday (19 October 1987). Trading was suspended for four days: the crash in the index over these four days led to a large loss for the capped system.

Trading costs

This example points out a limitation of the back-test, which assumes that it is possible to trade at the close price each day. In the difficult conditions on Black Monday, the uncapped system would probably have paid high trading costs, and might not have been able to complete its trade. By ignoring these issues across all markets, the back-test tends to favour the uncapped system, which often makes large trades in difficult conditions. We should bear this in mind when looking at Table 1.

The table shows the mean annual profit for each speed, and also the mean difference in annual return between capped and uncapped systems, with a standard error for this mean estimated by sampling with replacement (bootstrapping). This is probably an underestimate of the true sampling error since it neglects correlations between markets. However, it is clear that for each speed, the mean difference is small, positive, and not statistically significant. A more sophisticated estimate of the sampling error would not change this conclusion.

The results of our simple trend-following back test tend to agree with the conclusion from looking at the aftermath of large price movements. Uncapped trend-following systems make large trades after these movements, but there is no evidence that these large reactions are profitable. This is true even when we do not take trading costs into account. Including costs would

Trend following speed	Slow	Medium	Fast
Mean annual profit (uncapped)	2.5	2.9	3.1
Mean difference capped-uncapped	0.02±0.01	0.01±0.01	0.01±0.01

Table 1: mean annual profits of slow, medium and fast trend following systems (each targeting annual volatility of US$10M) across 100 markets, with mean difference between the profits of capped and uncapped versions of the systems. All figures are in millions of US dollars. No allowance is made for trading costs.

certainly improve the performance of the capped system relative to the uncapped one.

Large price movements have more often been followed by a rebound than by a continued trend. Because these large movements are rare, and the typical rebound is weak, the evidence on a single timescale is not statistically strong. But the pattern across a wide range of markets and timescales suggests that rushing for the exit as markets crash may not be the best course of action. A back-test of the effect of a trade cap on a simple trend-following system tends to confirm this conclusion, even before trading costs are taken into account.

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