Have markets become harder to trade?

30 January 2019, London

During the last few years it feels to us that there has been a pick-up in commentary that markets have become harder to extract profits from[1]. Blame has been pointed towards the rise of algorithms[2]. But beyond vague innuendo and poor manager performance, we have seen little hard evidence presented that anything is actually different.

This is the first in a series of notes exploring the reality of today's market dynamics and what the forward-looking implications could be for institutional investors and managers alike. In this note we undertake a study to explore the number of extreme market moves over time and find a notable increase in their occurrence from 2016 to the present. We discuss briefly how this shift in market dynamics may well be one factor behind managers' recent woes.

What is a shock?

For the purposes of our exercise we define a shock as a '5 sigma' daily return. We calculate a daily return as the daily difference in the log price in a market (roughly a percentage change in price). We use a rolling 33-day standard deviation of these returns as our measure of volatility, and in line with common practice call it sigma. We then look at the following day's price return divided by sigma. For example, if the last 33 days' daily return standard deviation was 1%, and the next day we see a move of 6% this would be recorded as a 6-sigma event. We define a shock as anything at or beyond 5-sigmas.

Should a 5-sigma event be called a shock?

In our exercise, an extreme move is one that is considerably larger than what investors would have been used to experiencing in the recent past. We use the word shock hesitantly. Investors probably use the term shock to describe an event that combines elements of both surprise and unpleasantness. In our first exercise below most of the 5-sigma events we find reflect price falls, so our definition would tick the unpleasantness box for most investors. But while 5-sigma events are by construction unusual, it is not clear we should be surprised that they arrive. Their timing may be impossible to anticipate, but we should know that they happen from time to time. You might even think that the longer we go without seeing one, our capacity to be surprised should drop. But for now we stick with the description of a 5-sigma event as a shock and later return briefly as to why they may cause pain.

S&P 500 - shocks since 1960

First, we calculated the number of shocks for the S&P 500. We used the market index (SPX

[1] For example, see 'A Hedge Fund Big Beast Is Killed by the Robots', Bloomberg, 13 December 2018 https://www.bloomberg.com/opinion/articles/2018-12-13/hedge-fund-trader-philippe-jabre-killed-off-by-robots

[2] For example, see 'Volatility: how 'algos' changed the rhythm of the market', Financial Times, 8 January 2019 https://www.ft.com/content/fdc1c064-1142-11e9-a581-4ff78404524e

Index from Bloomberg), but our qualitative results stand if we used a total return index or the futures price.

The period from 1960 to 2015 contains fourteen 5-sigma events. This number is considerably higher than one would expect if daily returns were normally distributed, but that should be of no surprise, as it had long been recognised that price return distributions are not normal. But fourteen events over 55 years suggests they are unusual (roughly one per thousand business days) and thus may not unreasonably be termed a shock.

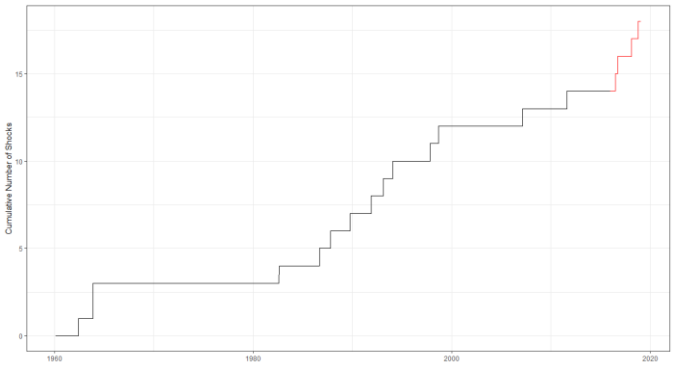

Figure 1 - A cumulative count of the number of 5-sigma events in the S&P market price since 1960. Source: Neuron/Bloomberg

Figure 1 shows a cumulative count of the number of 5-sigma events since 1960. The black line indicates the sample period until end 2015, and the red line corresponds to the period 2016 to present. We find that in the recent period running up to 2015 there were no more shocks than usual. However, from 2016 into 2019, we find four new 5-sigma events. In Table 1 we also suggest a proximate cause, based on our own opinion.

Date	# of 'sigmas'	Explanation
24-Jun-16	5.9	The Brexit Referendum
09-Sep-16	7.8	Fear over rising US rates
05-Feb-18	6.5	VIX ETP blow-up – sparked by US wage data
10-Oct-18	8.5	Fear over rising US rates

Table 1: Showing the date, significance level and explanation for the shocks since 2016. Source: Neuron/Bloomberg

It is not obvious as to whether this spate of shocks should be considered unexpected. History shows long periods with no shocks followed by periods when shocks occur more frequently. On the other hand, there are no other three-year windows since the 1960s in which there are four shocks or more.

One might have expected there to be more shocks in the volatile period around 2008, but as the background level of volatility was high, the size of daily returns did not exceed our 5-sigma threshold. For example, the 11.5% change on 13 October 2008 corresponded to just a 2.6 sigma event. It was a big change in absolute terms but it occurred during a period of heightened volatility.

Looking further back in time and across more markets

Given the irregularity of shocks since 1960 we have looked (in Figures 2 and 3) further back in time to 1900 using a daily series for the Dow Jones Industrial Average[3]. Firstly, we note a similar pattern to shocks as we found for the S&P when we zoom in on the common post 1960 sample, though now we find five since 2016[4]. But looking further back also indicates that in the 60 years before 1960

[3] Citation: Samuel H. Williamson, 'Daily Closing Value of the Dow Jones Average, 1885 to Present,' MeasuringWorth.com, 2018.

[4] One is marginal, and just slips under our 5-sigma filter for the S&P series.

there were double the number of shocks than during the following 60 years. We also show in Figure 4 that we need to look back as far the 1940s to find any 3-year windows in which there were more shocks than 2016-2018. Finally, in Figure 5, we looked over a wider range of markets (equity indices, bond and commodity futures) and counted the total number of shocks per calendar year. The chart speaks for itself, both 2016 and 2018 stand out as years in which there was a rise in the number of shocks across a range of markets.

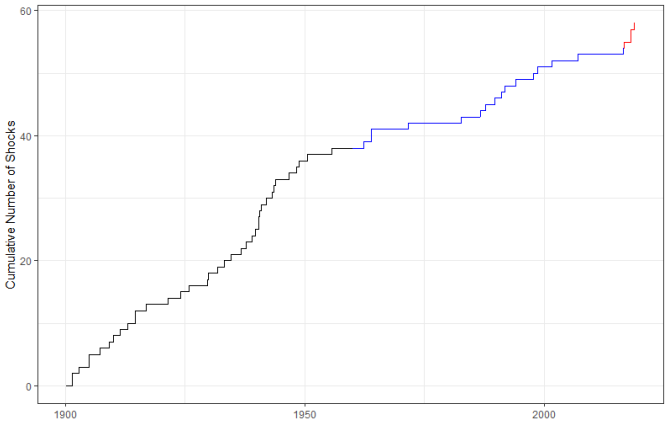

Figure 2 - A cumulative count of the number of 5-sigma events in the DJIA market price since 1900. Source: Neuron/MeasuringWorth.com

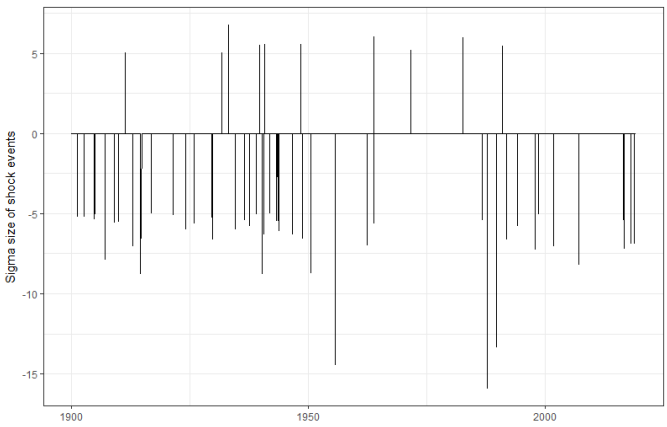

Figure 3 – All of the 5-sigma shocks in the Dow Jones since 1900 and their magnitude. Source: Neuron/MeasuringWorth

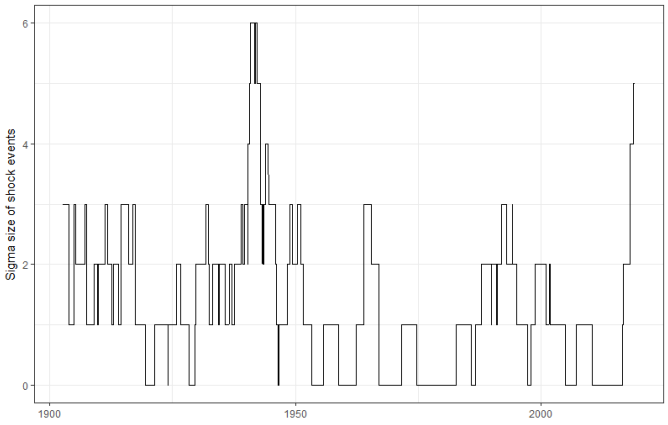

Figure 4 – Number of 5-sigma events in 3 year rolling blocks since 1900. Source: Neuron/MeasuringWorth

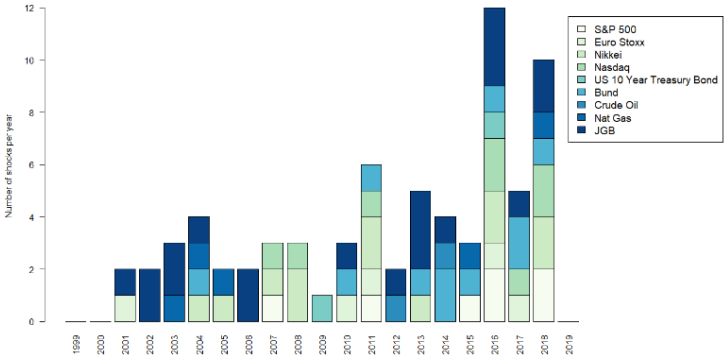

Figure 5 – Number of shocks aggregated by year for each market since 1999. Source: Neuron/Bloomberg

Final comments

Our note has explored whether we can detect anything different in market behaviour in recent years, to support the idea that markets are somehow different these days. Our main finding is that since early 2016 we have seen more shocks per comparable time period than at almost any time since the beginning of the last Century. We think this is consistent with grumblings from veteran traders that markets have become harder to trade.

Why might a shift in volatility dynamics be a problem?

A common practice amongst traders of all styles (for example, systematic and discretionary, quantitative and qualitative)

and strategies (for example, relative value or directional) is to size positions based on expectations of future market risk. Should market movements turn out to be significantly larger than those expectations we would expect traders to find themselves stopped out of trades more frequently than they had prepared for (curtailing their ability to capture potentially outsized gains), or to suffer greater losses than they expected.

Our findings based on counting extreme returns are consistent with (and in a sense are simply another manifestation of) the idea that volatility itself has become more volatile. One reason why perhaps it is hard to detect, let alone articulate what may have changed in markets is because concepts like the vol-of-vol (as it is referred to by option traders) are not exactly tangible. But maybe some popular risk management practices are being revealed to be exposed to this concept.

In the last couple of decades one of the empirical regularities of market volatility has become embedded within automated risk management processes. A key "stylized fact" of volatility is its persistence: low (high) volatility periods tend to be followed by low (high) volatility. This predictability has supported an aim of stabilising a trading strategy's (or portfolio's) volatility through time. The desire to produce stable strategy return streams has been symbiotically encouraged by growth in the commoditization of factors or dynamic strategies into ETFs and investible indices. Some investors like the idea of being able to pick-and-mix different factor return streams but they need the volatility of each of them to be stable to facilitate portfolio construction.

For those strategies that incorporate volatility targeting (where positions tend to be systematically increased as past volatility falls and decreased as volatility rises) a shift towards more frequent shocks that tend to be against the prevailing direction of markets is likely to be especially damaging.

We believe similar backward-looking risk-control mechanisms are a feature across a wide range of rules-based investment products, including alternative risk premia strategies. Is it possible a subtle shift in the higher order properties of market volatility could be behind the troubles for apparently diverse and historically uncorrelated strategies? Even more intriguingly, is it possible the rise in the use of algorithmic risk control mechanisms has contributed to a subtle change in underlying market dynamics?

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