Historical Volatility and Drawdown Analysis

**Manager Overview**

Analysis of fund performance during heightened periods of volatility provide an opportunity to improve our systems and strategies. In this report we look at three periods of significant drawdown: the dot com bubble, the 2008 financial crisis, and the covid-19 pandemic.

**Fund Performance and Recommendations:**

The trend strategy that is implemented by the fund suffers greatly under rapidly changing market conditions. I believe this to be a result of using a longer moving average coupled with the ability to quickly adjust to market downturns. To remedy this, I propose we look at two strategies. The first is that when there is heightened volatility that is 25% greater than the 256-day moving average we scale our positions back in proportion to account for the greater SR. The second would be to use a similar trigger as above and then scale down both our short and long term weighted moving averages to more quickly adjust to market conditions. By implementing these we could greatly reduce potential losses in major market drawdown events.

**Introduction**

Understanding our strategy’s behavior during periods of heightened market volatility provides an insight into how current strategies can be improved as a way to minimize catastrophic losses. For the purposes of this report a focus will be made, using asymmetric risk metrics, only on periods of extreme market drawdown. To find periods of significant drawdown and market instability we can turn to the volatility index which represents the standard deviation of S&P500, as shown in the graph below.

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As case studies we will look at model performance during three periods of drawdown: 1999-2000, 2008, 2020. The format of this examination will be an explanation of what happened and how our model responded using back testing data.

**1999-2000: Dot Com Bubble**

**Historical Analysis:**

The dot-com bubble of the late 1990s was driven by excessive investor enthusiasm for internet companies, leading to sky-high valuations without regard for traditional financial metrics. Low interest rates and the novel promise of the internet fueled a surge in venture capital funding for tech startups, many of which lacked solid business plans or revenue. This speculative wave resulted in a boom of Initial Public Offerings (IPOs), pushing the Nasdaq Composite Index to unprecedented heights despite many companies not turning a profit.

The bubble burst in the early 2000s when investors recognized the unsustainable valuations, causing a dramatic sell-off. The downturn was worsened by rising interest rates, which curtailed the easy capital that had propelled the market's rise. Failures of high-profile companies and accounting scandals further eroded confidence, leading to a severe market contraction. This correction forced a reevaluation of investment strategies, emphasizing fundamental financial health and viable business models, marking a significant shift from the speculative practices of the bubble era.

**Fund Performance:**

**2008: Housing Crisis**

**Historical Analysis:**

The 2008 financial crisis, a pivotal moment in global economic history, was precipitated by the collapse of the United States housing bubble and compounded by high-risk financial practices. Central to the crisis was the widespread issuance and trading of mortgage-backed securities (MBS) and complex financial instruments like collateralized debt obligations (CDOs), which were heavily invested in subprime mortgages. Financial institutions and investors, driven by the pursuit of higher returns, increasingly engaged in leveraging and speculative practices without adequate consideration of the risks associated with these mortgage-related securities. The proliferation of these risky assets, coupled with lax lending standards and an unprecedented rise in housing prices, led to a highly vulnerable financial system. When housing prices began to fall, and mortgage defaults increased, the value of MBS and CDOs plummeted, leading to significant losses for financial institutions worldwide.

The unraveling of the housing market exposed the fragility of the global financial system, triggering a liquidity crisis that rapidly spread beyond the United States. As the value of mortgage-related securities collapsed, financial institutions faced a severe shortage of liquidity, leading to the failure of major banks and investment firms. This liquidity crunch was exacerbated by the interconnectedness of global financial markets, where the default risk was significantly underestimated. The crisis was further deepened by the use of over-the-counter derivatives, which were not regulated and contributed to systemic risk. Government interventions and bailouts became necessary to stabilize the financial system, marking a significant shift in the role of central banks and regulatory authorities. The 2008 financial crisis underscored the need for stricter financial regulations and oversight, leading to comprehensive reforms aimed at preventing a recurrence of such a systemic collapse.

**Fund Performance:**

**2020: COVID-19**

**Historical Analysis:**

The 2020 financial crisis, also known as the COVID-19 economic crisis, was primarily triggered by the global spread of the coronavirus pandemic and the subsequent public health measures to contain it. Unlike previous financial crises, the root cause was not financial imbalances or market bubbles, but an exogenous shock that led to an unprecedented halt in economic activity worldwide. Governments and health authorities around the globe imposed lockdowns, travel restrictions, and social distancing measures to curb the spread of the virus, which directly impacted businesses, especially in sectors like travel, hospitality, and retail, leading to sharp declines in consumer demand and disruptions in supply chains. The stock markets experienced severe volatility, with major indices plummeting as investors grappled with the uncertainty and economic fallout from the pandemic. This sudden stop in economic activity and risk-off sentiment among investors triggered a liquidity crunch, affecting businesses' and individuals' ability to access finance and maintain operations.

In response to the crisis, central banks and governments implemented unprecedented fiscal and monetary policy measures to support the economy. Central banks slashed interest rates to historic lows and launched extensive quantitative easing programs to improve market liquidity and encourage lending. Meanwhile, governments around the world deployed massive fiscal stimulus packages, including direct financial assistance to individuals, loans and grants to businesses, and increased spending on public health. These interventions were aimed at cushioning the economic impact of the pandemic, stabilizing financial markets, and laying the groundwork for recovery. Despite these efforts, the crisis led to a significant contraction in global GDP, widespread unemployment, and increased public debt levels, highlighting the challenges of managing an economic downturn precipitated by a public health emergency and the critical role of coordinated policy responses in mitigating its effects.

**Fund Performance:**

**Summary of Fund Performance:**

These three test cases show that fund performance significantly suffers during times of increasing volatility. It should be noted that the fund performance is fairly standard when the rate at which volatility moves is stable, even if the actual measure is high. This is particularly evident in the 2008 example where we lost over 60% of our portfolio value between trading days 100 and 300. Now while this is only an example using one contract, and losses would be mitigated through diversification, the same pattern is reflected in the other two drawdown examples. The pattern being that the majority of our portfolio loss is not when volatility is high but rather it is changing. Given that volatility reflects a change in price, a rapid downturn in this case, it follows that our daily returns would be greatly scattered during this period however multiple days of losing over 8-9% of our entire portfolio, as seen in 2020, are unacceptable and there are several reasons that could contribute to this loss.

A trend-following strategy like this can suffer during times of increasing volatility due to the emergence of false trading signals and a delay in the strategy's adaptation to the new market conditions. Rising volatility causes markets to exhibit more erratic behavior, leading to premature or unnecessary trades based on misinterpreted trends, which can erode profits or accentuate losses. In addition, the sudden spike in volatility can cause a lag in the strategy's adjustment to the current market environment, resulting in decisions based on outdated assumptions. Additionally, the costs associated with trading, including spreads and slippage, tend to rise in volatile markets, which can significantly impact the profitability of frequent trading required by trend-following strategies. Managing risk also becomes more complex with larger than expected price movements, potentially leading to more frequent or larger losses. In contrast, during periods of consistently high volatility that accompany clear market trends, trend-following strategies often still perform well. Such conditions allow for significant profits from larger price movements, provided the volatility is part of a discernible trend and the strategy has adequately adjusted to the market's volatility level, including optimized trading costs and risk management practices. To address this, I propose a way of scaling our position inverse to volatility or adjusting our moving average as a way to mitigate downside risk during major market drawdowns.

**Suggested Pipeline Adjustment:**

There are two strategy options here that would provide an effective way to mitigate losses during significant market downturns.

1. When there is heightened volatility that is 25% greater than the 256-day moving average, we scale our positions back in proportion to account for the greater SR.
2. Use a similar trigger as above and then scale down both our short and long term weighted moving averages to adjust to market conditions more quickly.

For both strategies, this mitigation system will be triggered when market volatility increases substantially from previous levels; to be specific 25% greater than the 256-day weighted moving average. This serves to ensure that the system is only activated when market conditions are volatile enough to warrant a system that needs to quickly adjust holdings to avoid unnecessary losses. Strategy one requires us to pull out of positions to mitigate risk.

Historic testing via the trend strategy has shown significant losses when volatility increases. To mitigate this, I propose scaling back our positions proportional to the increase in volatility. For example, if volatility increased by 25%, we would then scale our positions back appropriately to account for the lower SR, as there is an increase in standard deviation. This would ensure that our portfolio is kept within the 20% risk parameter that we have set.

The second possible option is to scale down our moving average, allowing our system to adapt more quickly in volatile market conditions. This would be done by reducing our short- and long-term moving averages to half of their standard values. While it should be noted that this can result in overfitting if tested over a long period, this system would only need to be in effect for the duration of the rapid increase. Once the market begins to settle, we can revert to our regular moving day average.

By implementing either of these methods we can improve our risk management in time when traditional measures are not sufficient, ensuring stability and profitability in all market conditions.

**Other Losses:**

The equity curve, in the previous section, highlights two specific instances where the trend strategy has significant equity loss from non-major drawdowns. In 2016 and 2018 there are not significant periods of market drawdown but represent the biggest loss in our strategy.

Over the period from 5/21/2015 to 6/27/2016 our portfolio decreased from a high of approximately $1,675,000 to $791,775 making a loss in a little over a year of 52.73%. A similar pattern is repeated in 2018 where in 10 months, 8/29/2018 to 6/04/2019, we lost another 46.02% of our entire portfolio. Over this time the S&P 500 increased in value by the end of the period not explaining why we incur a loss. In both of these cases the market has a steep decline but sharply corrects, as seen in the graphs of each period below. It is most likely due to false signals or the signals not adapting quickly enough under real market conditions.

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**Additional Considerations:**

There are some additional considerations that should be made when discussing potential biases that could be present in our system that could exacerbate large drawdowns. There could also be issues using trend in a strategy heavily involving equites.

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| **Trend Following** | |
| **Starting Equity** | $ 100,000.00 |
| **Ending Equity** | $ 1,429,471.79 |
| **Return** | 1329.47% |
| **CAGR** | 9.39% |
| **Annualized Return** | 11.40% |
| **Annualized Volatility** | 21.97% |
| **SR** | 0.38 |

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| **Long Only Following** | |
| **Starting Equity** | $ 99,996.32 |
| **Ending Equity** | $ 1,887,752.16 |
| **Return** | 1787.82% |
| **CAGR** | 10.42% |
| **Annualized Return** | 11.74% |
| **Annualized Volatility** | 19.11% |
| **SR** | 0.46 |
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Looking at the report of the strategy we can see that a long only strategy presents higher profit with less risk and volatility. This is something that should not be overly scrutinized, but it should be noted. When presenting with new back tested data the trend strategy should outperform the long only strategy via better risk management.