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Drawdown control solutions: beware opportunity costs

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At a glance

- The principle of "no free lunch" also applies to portfolio insurance: stronger downside protection tends to be associated with higher opportunity costs
- Two solutions used to limit drawdown - volatility targeting and Constant Proportion Portfolio Insurance (CPPI) – have drawbacks
- With a view to minimizing opportunity costs while delivering a desirable level of downside protection, we propose two approaches
- These build on the idea of balancing absolute and relative drawdown solutions
- No single solution is perfect in all situations, therefore our approaches are tailored to cover a wide spectrum of applications

Balancing absolute and relative drawdowns: risk appetite and agnostic solutions

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We believe that the optimal portfolio insurance strategy should deliver a desirable level of downside protection at minimum possible opportunity cost.

Strategies to limit extreme drawdowns

Financial textbooks teach us that excess returns require taking risk. Being well aware of this common wisdom, investors are prepared to face periodic disappointment knowing that patience will eventually be rewarded. However, patience has its limits. When financial portfolios suffer large drawdowns, even the most loyal investors start questioning the benefits of risk-taking, and may eventually cut risk, which is almost always a suboptimal decision.

To avoid such situations, portfolio managers widely employ rule-based strategies whose objective is to limit extreme portfolio drawdowns. Among the multitude of different solutions in the industry, volatility targeting and Constant Proportion Portfolio Insurance (CPPI) are probably the most popular techniques.

Volatility targeting is a systematic strategy that maintains a constant level of portfolio volatility (or any other preferred measure of risk) over time. In periods of turbulent markets, this strategy automatically cuts the portfolio exposure to risky assets thus reducing the likelihood of severe drawdowns. The success of volatility targeting crucially depends on the ability to model portfolio risk in a reliable way, although that is no easy feat.

CPPI is an example of a purely performance-driven strategy. CPPI guarantees a minimum level of capital (floor) at all times by setting allocation to risky assets proportionate to the gap between the portfolio valuation and the floor. Due to its dynamic nature, CPPI does not have to rely on any assumptions about future return distribution to ensure the minimum capital guarantee.[1] Nevertheless, CPPI is not a perfect portfolio insurance either. It may turn out to be extremely costly due to missed performance opportunities.

[1] Strictly speaking, the multiplier should be sufficiently small to insure against gaps in prices.

Beware opportunity costs

Understanding the failure of CPPI is a good starting point in the quest for the optimal portfolio protection.[2] For the sake of ease, we will consider a "textbook" example of a portfolio consisting of a stock index and cash.

Adapted to drawdown control, pure CPPI rule[3] sets the weight of the index equal to the relative distance between current portfolio drawdown[4] and its maximum level defined by the investor's risk tolerance:[5]

$$\text{Index weight} = 1 - \frac{\text{Current drawdown}}{\text{Maximum drawdown}}$$

According to this rule, the portfolio is fully invested in the index only in the absence of drawdown. As the drawdown gets closer to its maximum value, the weight of the index is automatically reduced so that this level is never exceeded.

CPPI seems to provide perfect protection against excessive drawdowns, but CPPI comes at a price. Following a sufficiently large drawdown, the portfolio effectively moves almost like a cash instrument, which prevents it from catching up with market recovery in the future. Such a scenario, known as cash-lock,[6] may result in substantial opportunity costs.

To get an idea of the magnitude of opportunity costs, we consider a real-life example of a portfolio invested in the S&P 500 index and cash (money market). We assume that at the end of 2005 a portfolio manager decides to implement CPPI strategy for 10 years ending in 2015. This period covers the global financial crisis of 2008, which is a common case study for portfolio protection strategies. Exhibit 1 illustrates the performance of a pure CPPI strategy with 20% maximum drawdown and a weekly rebalancing frequency.

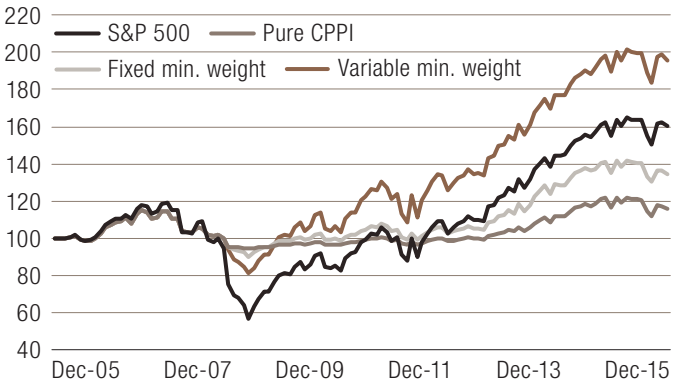
As expected, CPPI successfully keeps the portfolio drawdown under control. However, it fails miserably to keep up with the market recovery after 2008, as the portfolio stays flat. At the end of the holding period, the portfolio underperforms the S&P 500 index by as much as 45%.

Clearly, such a strategy is unsustainable, as investors would never tolerate performance drag on this scale.

Our example illustrates that the opportunity costs of CPPI can be quite substantial. In order to avoid the cash-lock and facilitate upside participation, the portfolio manager can impose a minimum index weight. Of course, this again comes at a price. The portfolio manager must give up the guaranteed protection as drawdown can potentially exceed the maximum level defined in the rule.[7]

Exhibit 1 shows gains and losses of such a strategy with a minimum index weight of 25%. Unsurprisingly, the realized portfolio drawdown gets deeper, however, this seems to be an acceptable sacrifice, taking into account a sizeable reduction in the performance drag.

EXHIBIT 1 PERFORMANCE OF CPPI DRAWDOWN CONTROL AND ITS MODIFICATIONS APPLIED TO A PORTFOLIO INVESTED IN S&P 500 INDEX AND CASH IN 2005 – 2015



Source: LOIM calculations. For illustrative purposes only. Past performance is not a guarantee of future results.

Introducing a minimum exposure to the index is obviously insufficient to save our strategy, which is still not responsive enough to the market upside. A more efficient approach would be to incorporate opportunity costs directly into the systematic rule. In this manner, the strategy would be more reactive restoring the investment when the performance drag becomes elevated.

[2] Capital protection represents a portfolio construction goal and cannot be guaranteed.

[3] CPPI was introduced by Black and Jones (1987) and extended to the drawdown control by Estep and Kritzman (1988).

[4] Portfolio drawdown is a non-negative quantity equal to the portfolio loss relative to its historical peak.

[5] Strictly speaking this is a version of CPPI with a unit multiplier. While this choice is at the lower end of the range of values used in applications, all conclusions remain valid for alternative specifications.

[6] Cash-lock refers to a situation when the portfolio remains in cash for the rest of the holding period.

[7] This will happen if the index goes all the way down.

To illustrate, we introduce a variable minimum weight determined by the portfolio drawdown relative to the index:[8]

$$\text{Index weight} \geq \frac{\text{Current relative drawdown}}{\text{Maximum relative drawdown}}$$

This minimum weight rule forces the portfolio to move closer to the index as its drawdown relative to the index becomes deeper. Relative drawdown seems to be an appropriate measure of the opportunity costs as it represents the performance missed from not fully investing in the index at a "right" time. In fact, absolute drawdown is also a measure of opportunity costs - this time, from not investing all in cash. Since we do not want to miss both opportunities, it is natural that the portfolio protection strategy incorporates both types of drawdowns.

Exhibit 1 shows the performance of the portfolio protection with the maximum relative drawdown set at the same level of 20% as the maximum (absolute) drawdown. This strategy successfully captures the market upside and even outperforms the S&P 500 over the holding period. While the realized maximum drawdown further increases, the benefit of the performance boost is clearly worth the trade-off.

[8] The relative drawdown is defined as the portfolio drawdown when portfolio value is expressed in units of the index rather than dollars.

Balancing costs and benefits in practice

Our study illustrates that incorporating relative drawdowns into the systematic rule achieves a better balance between costs and benefits of downside protection. At LOIM, we adopt two approaches that build on the idea of balancing absolute and relative drawdowns. We believe that no single solution is perfect in all situations.

The risk-budgeting rules used in two solutions are illustrated in Exhibit 2. The common principle is that the portfolio risk budget is decreasing in absolute drawdowns and increasing in relative ones. The "risk appetite" solution represents an extension of the linear rule of CPPI with a variable floor on the risk budget. This floor is defined by another linear rule that relates it to the magnitude of the relative drawdown. In situations when the absolute drawdown of the portfolio is zero, the risk budget is set at the maximum level, which reflects the preference for taking maximum possible risk (thus the name).

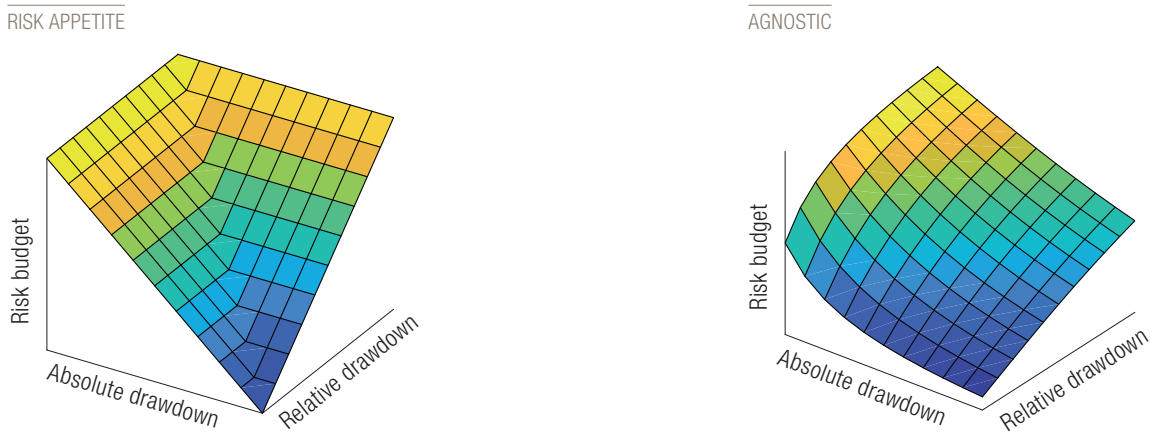
The agnostic solution implements a non-linear rule to determine the risk budget. It reduces risk much faster at the initial stage of the absolute drawdown accumulation, while the adjustment speed is decreasing with the magnitude of the absolute drawdown. As with the risk appetite solution, the minimum risk budget is increasing with the relative drawdown. However, the risk budget also recovers faster when the relative drawdown is larger. This solution builds on the prior-free[9] approach of Chassang (2018) with a time-invariant[10] extension described in Medvedev (2018). The optimal rule does not admit a closed-form formula, and requires the use of a numerical technique known as dynamic programming.

Of the two solutions, the agnostic one is clearly more conservative, as the risk budget is always below the maximum level. In particular, when both drawdowns are at zero, the strategy "meets in the middle" by allocating half the maximum risk budget (thus the name). This feature makes it problematic to apply the agnostic solution to traditional portfolios. Indeed, traditional asset portfolios are typically benchmarked against the full-risk investment. Therefore, it is highly desirable that the drawdown control gravitates towards the full risk utilisation. The risk appetite solution meets this requirement as it goes full steam whenever the absolute drawdown is zero.

At LOIM, we apply the agnostic solution to control drawdowns of equity portfolios relative to their benchmarks. In this specific application, the official benchmark (typically, the market-cap index) plays the role of cash as it corresponds to zero active risk, while the alternative equity index (for example, a smart beta portfolio) becomes the full risk option.

In a nutshell, the drawdown control takes the form of a dynamic allocation between the two equity indices. With the equity portfolio being benchmarked against the zero-risk option, we can "afford" to be agnostic.

EXHIBIT 2 TWO DRAWDOWN CONTROL SOLUTIONS: RISK APPETITE AND AGNOSTIC



Source: LOIM. For illustrative purposes only.

[9] Prior-free means the absence of assumptions about the probability distribution of returns.

[10] Time-invariant means that the strategy does not have a time dimension, which is applicable to situations when the investment horizon is not defined.

Conclusion

As in all areas of finance, the principle of "no free lunch" applies to portfolio insurance too: stronger downside protection tends to be associated with higher opportunity costs. Acknowledging this reality, we believe that the optimal portfolio insurance strategy should deliver a desirable level of downside protection at minimum possible opportunity costs. This is not an easy task as many factors need to be taken into account, and no single approach is perfect in any circumstances. At LOIM, we propose two solutions that cover a wide spectrum of applications.

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