

Theoretical Study on CPPI Strategy for Dynamic Adjustment of Risk Multiplier and Insured Amount

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Abstract

The traditional constant proportion portfolio insurance (CPPI) strategy is to set the risk multiplier (m) and the required insurance amount (f) according to the investor's risk preference and loss tolerance at the beginning of the period. Once set at the beginning, m will no longer change. f increases at a risk-free rate. Such a fixed rule of design rules makes it impossible for investors to effectively capture upward returns in the bull market, and it cannot effectively protect the downside risk in bear markets. Subsequent development of the time-invariable portfolio strategy (TIPP) strategy has changed the insurance bottom line adjustment rules, is no longer a fixed, although to make up for the risk of falling stocks in cpqi, but relative to the cpqi strategy tipp strategy seems too conservative, cannot effectively capture the stock's upward earnings. This paper proposes a new strategy of dynamically adjusting the risk multiplier and the amount of insurance coverage based on the stock price, taking into account the advantages and disadvantages of these two strategies, and changing the rules of the fixed risk multiplier and the amount of insurance coverage in previous strategies.

Keywords

CPPI strategy; TIPP strategy; dynamic guarantee limit; dynamic risk multiplier.

1. Introduction

Investment is the behavior of investors investing in certain assets or resources according to their own preferences in order to obtain excess returns in the future. Balancing the relationship between risk and return is the core consideration for investors to make decisions. After the financial crisis in 2008, investors learned lessons and realized the close relationship between the financial industry and the industry. The functional defects of the financial system itself and the consequences of systemic risks require the decision-makers to take into consideration when investing.

When there are no large-scale fluctuations in the background of the market. As a result of a company's own business or development issues caused by stocks have a significant ups and downs. Investors can hedge their risk reduction through investment portfolios based on the principle of "distribution of eggs in a basket". This is a risk or loss that arises for an individual company. Risks at this time can be dispersed by investing in assets with small or negative correlation coefficients, called non-systematic risks. Under the background of the market environment, due to common factors such as macroeconomic policies and changes in the political system, the risk that affects all investors in the market and cannot be eliminated by investing in decentralized assets is called systemic risk. The 2008 global financial crisis is a typical example of systemic risk.

In response to systemic risks, portfolio insurance strategies emerged. In 1981, Rubinstein M and Leland H E first proposed the concept of portfolio insurance and applied the technology to the securities investment market to manage the financial market risk and proposed an option-based replicating put policy. Subsequently, a variety of strategies such as buy-and-hold strategy, fixed portfolio strategy, fixed-rate portfolio insurance strategy, and time-invariant portfolio strategy emerged so that the portfolio insurance model developed rapidly. Due to the type of domestic funds and the characteristics of the market, CPPI strategies and TIPP strategies are widely used. Although the CPPI strategy can determine the investment mode based on the investor's own preference through simple parameter settings, the operation flow is simplified. However, its model premise assumes that

the investor's risk appetite in the entire investment period is not consistent with reality. The fixed risk multiplier and the amount of insurance coverage are the potential gains that investors in the bull market cannot well capture the rise in the market, and also bring the risk of loss when the market declines. The TIPP strategy to increase the amount of insurance under the current asset changes is more conservative than the CPPI strategy, which reduces the losses caused by the stock market decline. However, the conservative rules when the stock market rises do not make it very good to gain rising income.

The risk appetite of research investors based on behavioral finance will change with the changes of the outside world and their own emotions. On the basis of analyzing the parameter setting and operation mechanism of each strategy model, this paper proposes a portfolio insurance strategy that dynamically adjusts the risk multiplier and the amount of insurance coverage according to the stock price, in order to solve the system risk problem with a model more in line with the decision-making behavior of investors.

2. Portfolio Insurance Theory Basis

In daily life we all want to maximize our utility with the least risk. On the issue of risk and profit measurement, Markowitz's mean-variance theory has made modern finance develop and set off a culmination of a quantitative model to study investment issues. The effective method of avoiding systemic risks that cannot be eliminated by diversified investments can only be through investment insurance strategies. Therefore, it is very important to understand the concept and operation mechanism of portfolio insurance before optimizing and improving the model.

2.1 Portfolio Insurance Concept

In 1981, Rubinstein and Leland, professors of finance of the United States, proposed that the strategy of replicating put power marks the birth of a portfolio insurance strategy. Subsequently, various scholars optimized the concept of portfolio development and models. The reason why portfolio insurance strategies are loved by fund institutional investors such as capital preservation or pensions is because the core of portfolio insurance is to set parameters to ensure the value of the portfolio based on the investor's own risk preferences and tolerances. It can not only get the gains from rising market conditions, but also fail to fall below the initially set minimum value line when it falls.

When the strategy is run, financial derivatives and dynamic replication technologies are the basis for dynamically allocating risk assets and riskless assets. When the market conditions are in a rising market, they can buy more risky assets to gain rising income. When the market is falling, they sell risky assets to buy risk-free assets to reduce losses. Chasing and selling is its characteristic.

2.2 Portfolio Insurance Classification

According to the operating mechanism of portfolio insurance, it can generally be divided into two categories. In the beginning of the purchase of options or futures in the holding period does not make any adjustments to the static portfolio insurance such as European protective selling rights, European trust purchase rights, and other forms of reversible selling power. The other is a dynamic portfolio strategy that dynamically adjusts risk assets and riskless asset positions with simple parameter settings.

2.2.1 Static Portfolio Insurance Strategy

(1) European Protected Put Option

The European-style protective put-up right initially used in Europe was to purchase a risky asset in the market and a put option that targets the risky asset. Before the maturity date, no adjustments are made to the positions of the risky assets and the risk-free assets. Only on the maturity date will the option be executed. Only if the market price of the underlying asset is lower than the strike price will a put option be used to protect the capital. When the price of the underlying asset rises, it gives up the right to gain rising income. However, the drawback of this method is that it is very difficult for the financial derivative market to find the same underlying options as the risky assets at any time.

(2) Buy hold strategy

The buy-and-hold strategy is based on the risk appetite of investors to determine the appropriate asset allocation ratio at the beginning of the period. Regardless of market fluctuations in the short term, maintaining this combination for several years does not change the state of asset allocation. The idea is simple and easy to apply to strategic investors. When the market rises, the larger the proportion of investment in risk assets at the beginning of the period, the greater the upward earnings, and vice versa. Although this strategy exposes the portfolio to full exposure to market risk, it also has the advantage of being small and manageable in terms of transaction costs, and the portfolio's return is directly related to the price volatility of risky assets.

2.2.2 Dynamic Portfolio Insurance Strategy

(1) Constant portfolio strategy

The fixed portfolio strategy is simply the ratio of fixed risk assets to riskless assets throughout the insurance period. Risky assets use stocks as an example. When the stock price rises on a fixed-principle basis, some stocks need to be sold to reduce the proportion of risky assets. When the stock price goes down, stocks need to be bought to increase the proportion of risky assets. It is a strategy of buying low and selling high.

(2) Constant proportion portfolio insurance strategy

In order to solve the drawbacks of the European-style protective put option strategy with low computational complexity, a CPPI strategy was proposed. Investors use this strategy to set appropriate parameters through their own risk appetite and acceptable losses. According to simple parameter settings, they can automatically adjust the position of risky assets and riskless assets. Once the parameters are set, the entire investment period will not change. The fixed ratio is the proportion of risk assets and cushions. When the stock price rises, the new security mat is recalculated according to the amount of insurance coverage to obtain the position of the risky assets. The rest is invested in risk-free assets and the calculation is repeated until the end of the period.

(3) Time-invariant portfolio insurance strategy

Ested and Kritzmant proposed a TIPP strategy that is very similar to CPPI's strategy in 1988. The difference is that the TIPP policy's insured amount is continuously adjusted as the portfolio assets change. This strategy allows investors to protect the current asset value rather than the initial asset value. Therefore, each time the position of a risk asset is recalculated, the product of the product of the value of the previous period's preserving value, the total asset value of the current period, and the ratio to be guaranteed is selected to be the larger one for the current period. By setting the amount of coverage, we can see that it is a more conservative strategy than CPPI.

3. Dual Dynamically Adjusted Portfolio Strategy

This article mainly combines the advantages of CPPI and TIPP strategies to improve the model and proposes a dual dynamic adjustment of investment strategy. The following will describe the operation mechanism of the two strategies in detail, and analyze their advantages and disadvantages, and propose an improved strategy model.

3.1 Operating Mechanism

The CPPI strategy sets the initial risk multiplier and the amount of insurance coverage according to the investor's risk preference and tolerance. The difference between the asset value at the beginning and the amount to be guaranteed is the safety mat, $C_0 = V_0 - F$. Risk asset value $M_0 = C_0 \times M$. The remaining investment in risk-free assets $D_0 = V_0 - M_0$. M remains unchanged throughout the insurance period. F grows with risk-free interest rate $F_t = F_0 \times e^{rt}$. At time $t=1$, the position $C_t = V_t - F_t$, $E_t = m \times C_t$, and $D_t = V_t - E_t$ are recalculated according to the change in total assets at this time, and the above process is repeated until the end of the period.

The TIPP strategy is similar to CPPI. It is only on its basis that the amount of insurance coverage

needs to be dynamically adjusted. In each period of adjustment, compare the amount of the insured amount of the previous period with the total value of the assets in the current period and the proportion of the assets to be guaranteed, and select the larger one as the amount of the insured for the current period. The adjustment process is as follows: $C_t = V_t - F_t$, $E_t = m \times C_t$, $D_t = V_t - E_t$, $F_t = \max(F_{t-1}, f \times V_t)$. When the stock price rises, the amount of insurance coverage is more conservative than the CPPI strategy.

3.2 Dual Dynamic Adjustment Mathematical Design

From the above policy operation process, we can see that the CPPI strategy's return on the bulls is better than the TIPP strategy. However, when the market conditions are not good, there will be greater losses. The conservative TIPP strategy has a better effect in protecting short-term capital, and the long-term profit capture ability is weaker than the CPPI strategy. The traditional CPPI strategy assumes that the investor's risk appetite has remained unchanged during the investment period, but from the perspective of behavioral finance research, the investor's risk appetite will change with the influence of external factors and their own emotions. Therefore, this paper proposes to combine the advantages of the two strategies to adjust m and F at the same time according to the change of stock price.

Take the cpqi policy as an example. At the beginning of the period, m and F are set according to investor risk preferences. The initial assets consist of the required coverage and safety mat $V_0 = C_0 + F_0$. The initial capital can also be expressed as risk assets and risk-free assets $V_0 = E_0 + D_0$. Risk assets $E_0 = M_0 \times C_0 = M_0 \times (V_0 - F_0)$. The risk asset position is equal to the product of stock price (S_0) and shareholding (N_0) $E_0 = S_0 \times N_0$. Then $V_0 = E_0 + D_0 = S_0 \times N_0 + D_0$. The total assets differentiate the risk assets by $dV_0/dS_0 = N_0$. Explain that risk assets affect total assets through shareholding. from the above available $S_0 \times N_0 = M_0 \times (V_0 - F_0)$ and then derivative of the shareholding amount available: $S_0 dN_0 + N_0 dS_0 = M_0 dV_0 + V_0 dM_0 - M_0 dF_0 - F_0 dM_0$.

Adjustment can be obtained: $dN_0 = [M_0 (dV_0 - dF_0) + dM_0 (V_0 - F_0) - N_0 dS_0] / S_0$.

From the above formula can be seen that the amount of change in the shareholding is the amount of change in the asset dV , the amount of change in the amount of protection dF , the amount of change in the risk multiplier dM , the amount of change in the stock price dS .

Taking into account the CPPI strategy fixed risk multiplier and the amount of insurance coverage and TIPP strategy is relatively conservative rules, in order to get the upper reaches of the benefit, short-term protection of the risk of decline, must be based on changes in the price of the stock price dynamic adjustment of the risk multiplier and the amount of insurance coverage. Based on the above ideas, the principle of improvement of the cpqi strategy model is to dynamically adjust m and F based on the rise and fall of stock prices. The specific approach is to increase m when the stock price rises, and f remain unchanged to obtain upward returns. When the stock price declines, m becomes smaller and f becomes larger to protect the downside risk. The specific adjustment factor is $m_t = m_{t-1} + a \ln(s_t/s_{t-1})$; $F_t = F_{t-1} + (-a) \min(\ln(s_t/s_{t-1}), 0)$. M_t denotes the risk multiplier after the t -th adjustment, s_t denotes the stock price of the t -phase, F_t denotes the amount of the guarantee after the t -th adjustment, and a denotes the investor's sensitivity to risk and return. Thus, the risk multiplier that is adjusted in the long position can well capture the upward earnings. When the short-term risk multiplier is adjusted, the increase in the amount of the insurance limit can be used to better fulfill the capital preservation requirement of the portfolio strategy.

4. Conclusion

This article reviews the operating mechanism of cpqi and tipp strategies. Comparing their advantages and disadvantages, they found that the traditional fixed risk multiplier and the cpqi strategy for the amount of insurance required investors to not be able to effectively capture upward returns in the bull market and could not effectively protect the downside risk in the bear market. Compared with the cpqi strategy, the more conservative tipp strategy to ensure that the amount of insured capital makes up the risk of falling stocks in cpqi, but it can't effectively capture the stock's upward earnings. Based

on this comprehensive consideration of the advantages and disadvantages of these two strategies, we propose a new strategy to dynamically adjust the risk multiplier and the amount of coverage according to the stock price. Changing the rules of the fixed risk multiplier and the amount of insurance coverage in previous strategies will enable the combined insurance strategy to better play its benefits and preserve capital.

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