Theta Research Notes #5

THETA
CAPITAL MANAGEMENT B.V.

DE LAIRESSESTRAAT 180
1075 HM AMSTERDAM
THE NETHERLANDS
T +31 20 5 722 733
F +31 20 5 722 744
I WWW.THETACAPITAL.COM

Funding Equity Call Options with the Returns from a Balanced Portfolio of Bonds, Real Estate and Hedge Funds

Theta Portfolio Simulations

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Wouter ten Brinke
Bernard Boonstra

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Introduction

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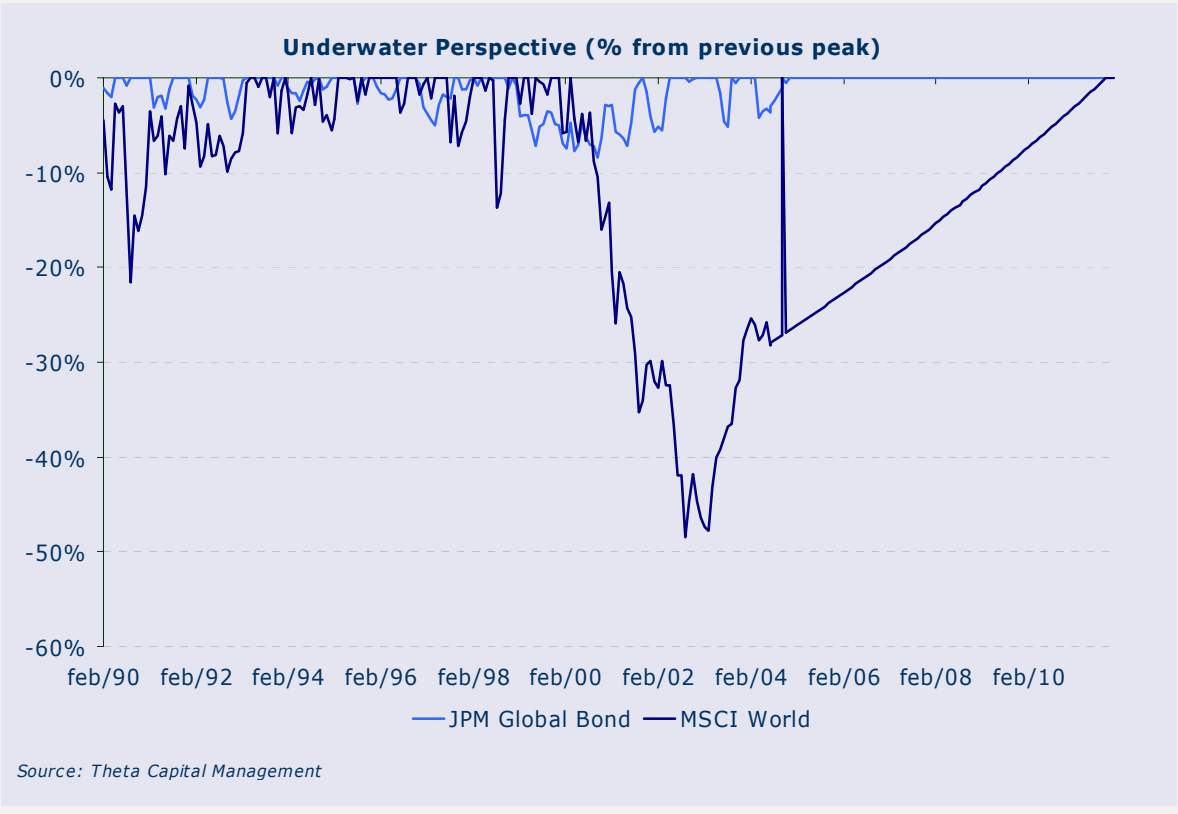
The following analysis aims to provide insight into the sensitivities of risk and return to changes in allocations in a balanced portfolio of bonds, real estate and funds of hedge funds. The starting point is our client's intention to offer its clients to reduce allocations to equity and switch to bonds, while maintaining upside potential through a call option on an equity index.

The combination of a bear market in equities, a low interest rate environment and newly enforced regulations poses a challenge to Dutch pension funds. First, losses on equity positions have eroded liability coverage. Second, while stock market losses have partly been offset by gains on fixed income investments, the current low interest rate environment poses new challenges:

- Low current income to fund short-term liabilities
- Risk of capital losses on existing bond positions
- Solvency requirements

As a result, pension funds have become sensitive to volatility of their investments. Despite the inherent focus on matching liabilities in the long term, intermediate volatility of asset returns has become an issue. Chart 1 below illustrates that equity is a very volatile asset class and that drawdowns are substantial from time to time. Moreover, the current value of global equity positions is still around 30% below its recent peak ('underwater'), and it may take another eight years before they are above water again.

Chart 1 Investors are sensitive to investment losses



Source: Theta Capital Management

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Starting Points

Although this might suggest to drastically reduce the equity allocation in pension fund portfolios (in order to reduce short-term portfolio volatility), the risk of foregoing the upside potential of equities is also high: portfolio returns may prove to be insufficient to cover liabilities in the long term.

Starting Points

The client has the intention to advise its clients to reduce the allocation to equities and switch to bonds, thereby reducing portfolio volatility considerably. However, to maintain the upside potential of equities, it is suggested to buy a call option on an equity index or a basket of equity indices (essentially providing a leveraged long exposure to equity markets, financed by the bond position). This sets two requirements for the 'funding portfolio':

1. the expected portfolio return must exceed the call option premium plus the foregone dividend yield;
2. the risk that the portfolio return is lower than this sum must be minimized.

Since the cost of such an option strategy (the call option premium) lies well above the return on bonds, one may consider adding other asset classes with higher risk-adjusted returns. It is our understanding that the client is considering a combination of bonds (government & investment grade corporate bonds), real estate and funds of hedge funds.

This analysis aims to provide insight in the risk-return characteristics of such a portfolio. We define risk not only as the volatility of portfolio returns, but also -and maybe more importantly- as the probability that the portfolio returns will be lower than the call option premium (*shortfall risk*). Furthermore, we look at the sensitivities of the risk and return parameters to changes in allocations between bonds, real estate and funds of hedge funds.

In our analysis we make the following assumptions:

- The equity index is represented by the Dow Jones Eurostoxx 50 Index;
- The premium for a five-year ATM call option on the DJ Eurostoxx Index is 13% (end October 2004). This equates to about 2.50% per annum;
- The foregone dividend yield on the DJ Eurostoxx 50 is 2.75% per annum;
- This brings the total cost of the call option strategy to 5.25% per annum over the five-year period;
- Bonds are represented by the current 5-year swap rate (in euros), which is 4.12% per annum with a volatility of 3.5%. This is the expected return of holding a 5-year high-investment grade (AA-rated) bond until maturity;
- Real estate is represented by the MSCI Europe Real Estate Index, with a long-term (10-year) historical return of about 8% and a volatility of 11% per annum. This is a market-cap weighted index that monitors real estate stocks in Europe;
- Hedge funds are represented by the HFR Conservative Fund of Fund Index, with a long-term (10-year) historical return of 8% and a volatility of 3.5% per annum.

In order to generate risk-return profiles for the various combinations of bonds, real estate and hedge funds, we ran 5000 Monte Carlo simulations based on available data from January 1993 to September 2004, the results of which are discussed below.

Simulation Results

The charts below display the following risk-return parameters for the funding portfolio:

- Shortfall risk, which is defined as the probability that the average annual return on the funding portfolio is lower than 5.25% (cost of option strategy);
- Expected portfolio return;
- Sharpe ratio, i.e. the excess return over the risk-free rate of 4% divided by the portfolio volatility.

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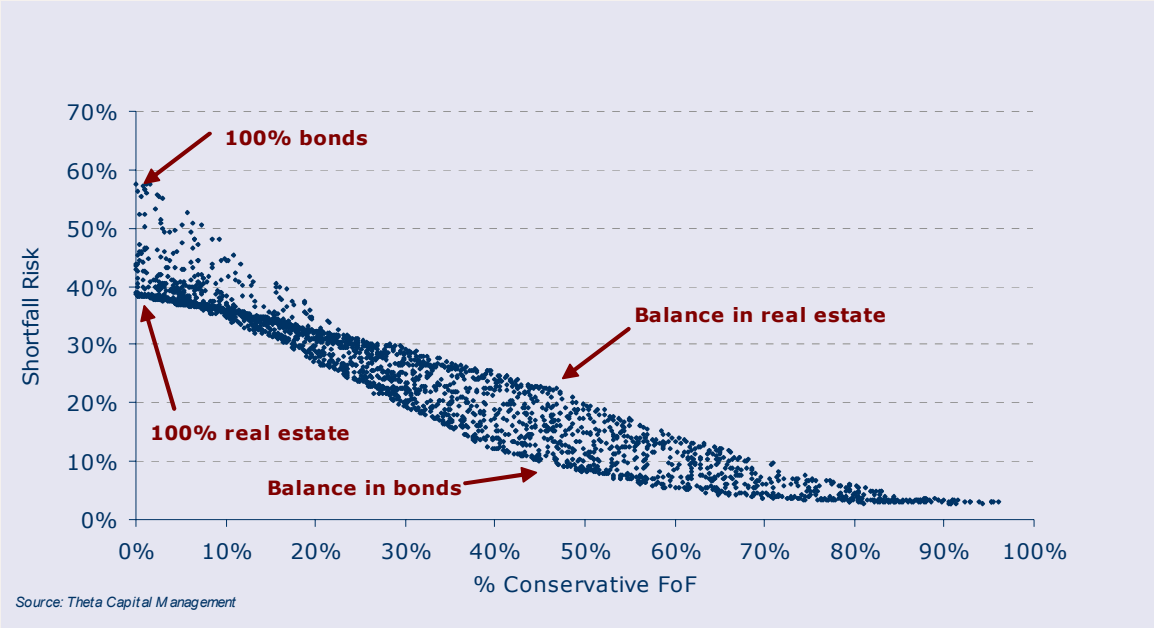
Shortfall Risk

Each dot in the scatter diagrams represents a portfolio of bonds, real estate and funds of hedge funds. Risk-return parameters for each of these portfolios are obtained by performing 5000 simulations based on the inputs discussed above. All charts display shortfall risk on the y-axis and the allocation to conservative funds of hedge funds on the x-axis. They can be read as follows: holding the hedge fund allocation constant, varying combinations of real estate and bonds provide varying degrees of shortfall risk of the portfolio. Obviously, placing hedge funds on the x-axis is merely a matter of presentation; one could also choose to place bonds or real estate on the x-axis and vary the remaining two asset classes. Chart 2 below clearly demonstrates that adding conservative funds of hedge funds to the funding portfolio reduces shortfall risk considerably. Without hedge funds, the shortfall risk is on average 50%, depending on the remaining allocations to real estate and bonds. A funding portfolio with only bonds has a shortfall risk of almost 60% and with only real estate this falls below 40%, driven by higher returns on the latter. However, with about half of the funding portfolio in hedge funds, shortfall risk can be reduced by a factor of 4.

Chart 2 Conservative funds of hedge funds reduce shortfall risk

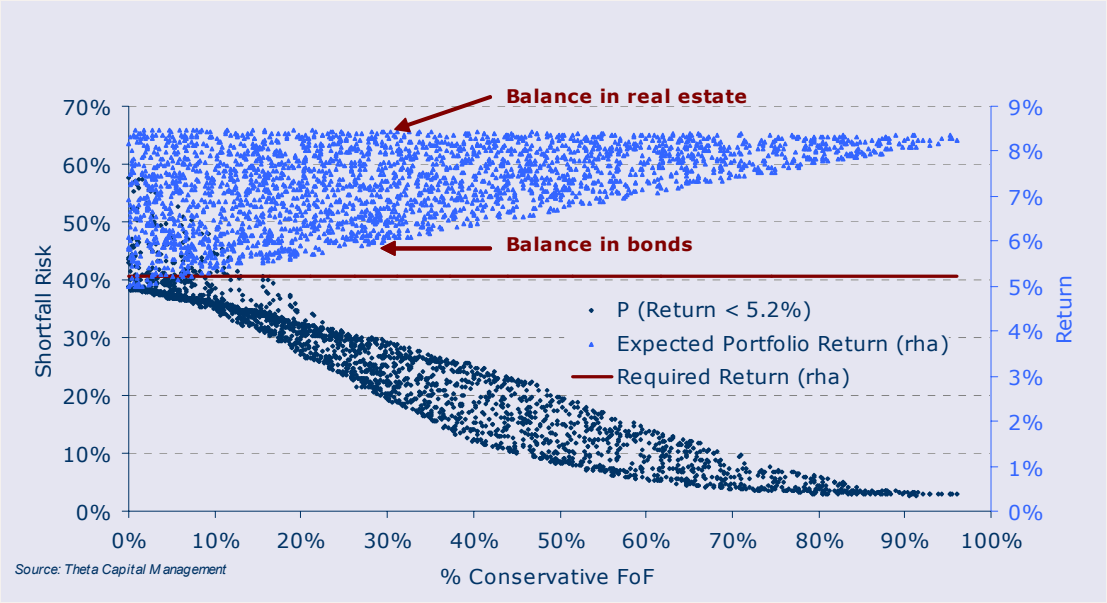


Source: Theta Capital Management

Another interesting observation is that beyond a hedge fund allocation of 25%, the driver of shortfall risk changes. That is, the largest reduction in shortfall risk can be achieved by allocating the balance of the funding portfolio to bonds rather than real estate! In addition, with an allocation of 25% to hedge funds there seems to be an inflection point where the remaining allocation to bonds and real estate is less relevant. While this may suggest an 'optimal allocation', we note that allocating more to conservative funds of hedge funds can achieve a substantial further reduction in shortfall risk.

Returns & Shortfall Risk

Chart 3 Portfolio returns and shortfall risk

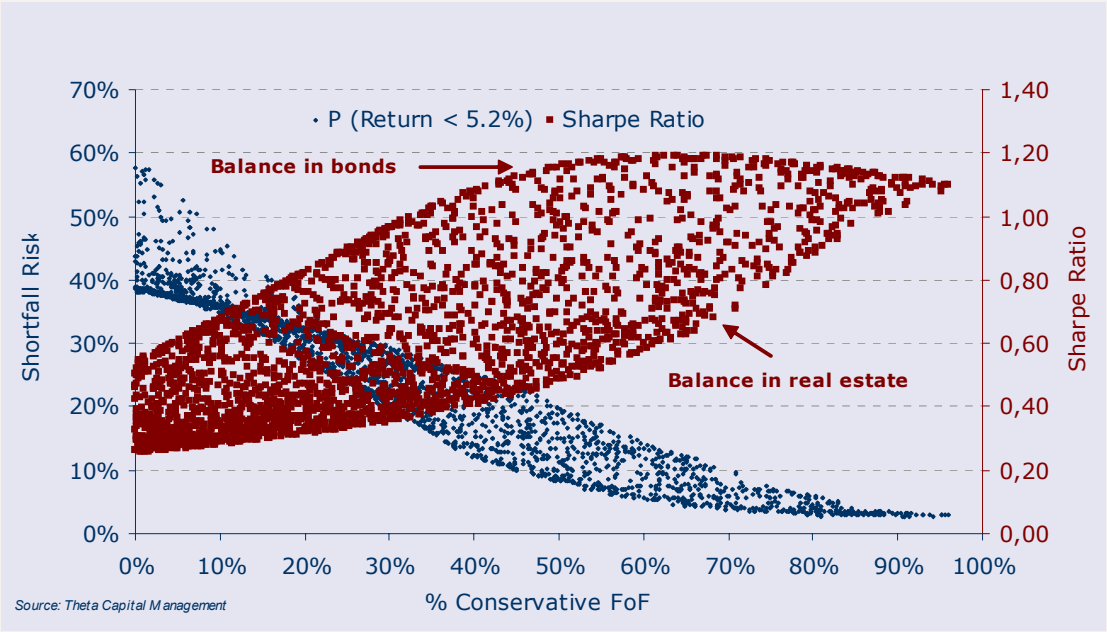


In chart 3 above, we add the expected return and required return on the funding portfolio (light-blue dots and red line respectively, right-hand axis). It shows that, with an allocation to conservative hedge funds of 10% or more, the expected portfolio return exceeds the required return (with the exact amount dependent on the remaining allocations to bonds and real estate). However, the probability of not meeting the required return is still about 40%! Again, increasing the allocation to hedge-funds raises the expected portfolio return (for different combinations of bonds and real estate), while lowering shortfall risk considerably.

The trade-off that is illustrated in chart 3 is the one between increasing expected portfolio return through real estate and lowering the shortfall risk by allocating more to bonds (for any given level of hedge funds).

5 Conclusion

Chart 4 Hedge funds and bonds improve risk-adjusted returns and reduce shortfall risk



Source: Theta Capital Management

In chart 4 below we replace the expected return with the Sharpe ratio of the funding portfolio. In addition to the shortfall risk, it also introduces return volatility as a risk measure. It clearly demonstrates that the highest risk-adjusted return can be achieved by allocating between 50% and 60% of the funding portfolio to conservative funds of hedge funds, and the balance in bonds. This allocation generates an expected return between 7% and 8% with volatility below 4% and a probability of not meeting the required return of only 10%. This result is mainly driven by the high volatility of real estate relative to those of bonds and hedge funds.

Conclusion

The combined analysis of the different return outcomes with the risk that the stated target return will not be achieved, clearly argues for a substantial allocation to conservative funds of hedge funds:

- higher returns on hedge funds combined with lower volatility of returns reduces the risk of not achieving the target return (5.25% p.a.) considerably;
- the investment objective is achieved with lower intermediate portfolio volatility;
- a holding of about 25% in hedge funds provides maximum flexibility with regards to the remaining allocations to bonds and real estate;
- the highest risk-adjusted return (both in terms of intermediate volatility and shortfall risk) can be achieved by allocating approximately half of the 'funding portfolio' to hedge funds.