COMPARATIVE PERFORMANCE OF CAPITAL PROTECTION STRATEGIES IN THE SOUTH AFRICAN MARKET

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By

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Abstract

The performance of cash protection strategies implemented in the South African market are investigated in order to establish if investors are able to add value through the use of dynamic portfolio insurance methods. The analysis is performed, using monthly data, from January 1961 to August 2014 using six alternative methodologies including both a Fixed Rate and Rolling Average Stop-Loss approach, a Lock-In approach, a Constant Mix strategy, a Constant Proportion Portfolio Insurance (“CPPI”) approach and an alternative CPPI approach using a Ratchet mechanism. The results indicate that the use of such cash protection strategies can markedly improve portfolio performance from a risk return perspective compared to a pure diversified investment strategy. Notably, the use of older, simpler trading strategies such as the Stop-Loss and Lock-In approaches at optimum threshold levels can still offer investors higher risk to reward benefits with less commitment required. These strategies, though, lack the flexibility observed with the more recently developed dynamic trading strategies in terms of providing for varying risk appetites.

Keywords: Constant Proportion Portfolio Insurance, Stop-Loss, Lock-In, Constant Mix, Sharpe ratio, Dynamic asset allocation

DECLARATION

Student Number: DPLRIC002

I, Richard Michael du Plessis, declare that:

Comparative Performance of Capital Protection Strategies in the South African Market

Is my own work and that all the sources that I have used or quoted have been indicated and acknowledge by means of complete references.

Signed by candidate

5/15/2015

Signature Removed

Signature

Date

Richard du Plessis

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1. Table of Contents

1. INTRODUCTION

In recent times, global financial markets have experienced numerous periods of crisis characterized by large volatility such as the Asian Financial crisis in 1997, the stock bubble crash in 2001 and, on a much larger scale, the Sub-prime mortgage crisis in 2008 and the ensuing recession. In this regard, Modern Portfolio theory fails in its assumption that diversification can reduce the total risk of a portfolio through its ability to reduce firm-specific risk. In these times of volatile market conditions, the systematic or market risk of a portfolio increases exponentially leading to large scale losses globally. As a result, the need for strategies protecting investment portfolio values from large scale downside risk has increased dramatically, leading to the implementation of various portfolio insurance methods by investment banks around the world. This paper focuses on capital protection based structures involved in managing the balance of assets between risky assets (usually some form of equity/index) and a riskless asset such as short-dated government bonds. This combination between the two asset classes is rebalanced depending on the performance of the risky asset class or in some cases simply a one-time shift into the risky asset in order to guarantee an original capital investment and minimize downside risk.

The increase in the effects of contagion, whereby the globalization of markets leads to the economic changes in one country spreading to others, has resulted in developing nations, such as South Africa, being greatly exposed to financial crisis' experienced in other regions. In addition, the lower number of stocks traded on the Johannesburg Stock Exchange in comparison to larger stock exchanges in North America and Europe, as well as the common perception that developing countries' markets are less efficient, leads to these markets experiencing greater volatility of returns. As a result, portfolio insurance in South African markets may, perhaps, be even more beneficial than expected due to that increased volatility experienced and therefore research into various capital protection approaches using South African data may be worthwhile and of great use to academics and practitioners alike. Specifically this paper seeks to provide further insight into capital protection methods by examining 6 different dynamic asset allocation strategies. The traditional Stop-Loss (both Fixed Rate and Rolling Average) and Lock-In strategies, a Constant Mix strategy, a Constant Proportion Portfolio Insurance (CPPI) strategy and a CPPI strategy with a ratchet lock-in approach. It is interesting to see the relative performance when different floors, trigger prices and asset allocations are used and, in theory, can potentially identify an effective method of portfolio insurance in the South African market and hence ascertain whether one or more strategies could be a viable option for risk-averse investors seeking capital protection. An analytical comparison is conducted using the returns of the All Share Index (ALSI) and the 6 strategies being tested.

The structure of this study is as follows. Section 2 will entail a concise theoretical background to modern portfolio theory and the basis for portfolio insurance, while section 3 will include a literature review on the comparative performances of various cash protection strategies. Section 4 presents the data and methodology that will be used in order to understand and analyse the relative returns-based performances of the various cash protection strategies, including the relevant statistical measures. Section 5 details the results of the performance of the five cash protection strategies individually using numerous variables in order to determine the optimal outcome under each strategy, after which we compare the various protection strategies against one another with the aim of finding the optimum approaches to be used when implementing cash protection investment tools for both risk-averse and risk-seeking investors. We further evaluate our results under different sub-periods with the intention to further validate our findings. Finally section 6 provides a concise conclusion on the findings of this paper.

2. THEORETICAL BACKGROUND

2.1 Overview of Modern Portfolio Theory involving a portfolio containing a risky asset and a risk-free asset

The concept of Modern Portfolio Theory (MPT), developed by Markowitz in 1952, allows us to derive a relationship between the risk and return of a portfolio of financial assets and provides the foundations for the concept of the Capital Asset Pricing Model (CAPM), a commonly used method of calculating the value of assets globally (Wan, 2000).

It is important to distinguish between the two asset classes involved, notably risky assets and risk-free assets. Firstly, a financial asset can never be entirely risk-free and therefore the term risk-free is used to describe an asset that has the lowest level of risk amongst available asset classes. It is common practice in South Africa to estimate the risk-free rate by utilising the 3 month T-bill as well as short term government bond yields such as the R150 and R153 (Strydom and Charteris, 2009). The motivation for using these securities as a proxy for the risk-free rate is twofold. The taxing power the government possesses provides virtual certainty against bankruptcy and therefore assurances around the ability to raise money and make interest and redemption payments on the securities. The reason that a 3 month T-bill is favoured so highly is due to the fact that it is the shortest government security available and therefore less sensitive to changes in interest rates and inflation. The rate of return on this risk-free asset is known as the risk-free rate and is used in the CAPM as a benchmark or lowest level of return for calculating the expected returns on a risky asset. The risky asset, usually some form of equity, is priced using this benchmark as well as additional return (risk premium) expected as a result of the greater risk inherent in this security. (Treynor, 1962)

$$E(R_r) = R_{rf} + R_p$$

= minimum compensation + compensation for taking additional risk

A portfolio consisting simply of these two types of assets with a proportion of w invested in the risky asset and therefore $(1 - w)$ invested in the risk-free asset would have a return function;

$$R_p = w.R_r + (1-w).R_{rf}$$

Where R_r is the return on the risky asset and R_{rf} is the risk-free return. Hence the expected return of the portfolio $E(R_p)$ can be determined as follows

$$E(R_p) = w.E(R_r) + (1-w).R_{rf}$$

$$= R_{rf} + w.[E(R_r) - R_{rf}]$$

The risk of the portfolio, expressed using Standard Deviation, is determined assuming there is no correlation between the two asset classes as the risk-free rate is assumed to be independent of equity markets. This occurs as a result of the fact that short term T-bills as well as short term government bonds are utilised as a proxy for the risk-free rate. These instruments possess little, if any, duration risk in comparison to a 30 year bond exposed to fluctuations in yield and price, and are therefore not affected by financial market movements. (Lettau and Wachter, 2007)

It is hence calculated as follows:

$$\sigma_p = \sqrt{w^2\sigma_r{}^2 + (1-w)^2\sigma_{rf}{}^2} = w.\sigma_r$$

As discussed earlier, MPT defines a relationship between risk and return of a portfolio. In order to look at that relationship, we need to combine the above equations used to determine expected returns and risk. From equation the equation above, we can express w in terms of the Standard Deviation of the portfolio and the risky asset seen below.

$$w = \frac{\sigma_p}{\sigma_r}$$

Substituting the above into our expected return equation provides us with a formula for expected returns for a portfolio:

$$E(R_p) = R_{rf} + \frac{\sigma_p}{\sigma_r}.\left[E(R_r) - R_{rf}\right] = R_{rf}\ \frac{\left[E(R_r) - R_{rf}\right]}{\sigma_r}\sigma_p$$

This equation is known as the Capital Allocation Line (CAL), shown in figure 2.1 below, and provides a risk-return relationship for a portfolio consisting of a risky asset and a risk-free asset as used in this paper. The CAL slope co-efficient represents the price received for the additional risk of the risky asset and along with the total risk of the portfolio indicates the total amount of compensation received for taking on this additional risk. This relationship provides the foundation for the basis of this paper, as the objective is to test portfolios using varying strategies in order to maximise this trade-off between expected returns and risk. A measure such as the Sharpe ratio, developed by William Sharpe in 1966 and explained in more detail in the methodology section of this paper, will help examine this risk to reward trade-off.

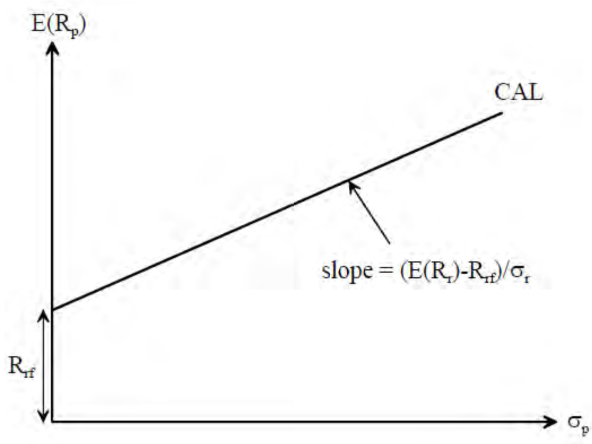

Figure 2.1

2.2 Basic concept of Portfolio Insurance

Portfolio Insurance refers to any strategy that protects the value of an investment composed of risky assets. The risky assets can be any investment instrument such as stocks, bonds, currencies, commodities, real assets or even credits. If the value of the risky asset decreases, the insurance or hedge increases to offset the decrease in price of the risky asset. If the price of the risky asset were to increase, the value of the entire portfolio would, in turn, still rise. It is important to note that the cost of insuring the portfolio against downside risk should, however, always lead to an insured portfolio possessing lower returns should prices increase.

Portfolio insurance allows market participants to alter their return distributions and in doing so cater for various investor's preferences with regard to the risk of their individual portfolios. While some investors may prefer the greater upside potential offered by an uninsured portfolio, risk-averse investors will favour the limited-risk characteristics of an insured portfolio.

The most common form of portfolio insurance used by financial institutions today involves hedging and the use of short-selling. This is the practice of selling securities or other financial instruments that are not currently owned by the investor, with the intention of subsequently repurchasing them at a lower price.

Option Based Portfolio Insurance, introduced by Leland and Rubenstein in 1976, is another traditional, yet popular method of protecting a portfolios value, either directly on the portfolio or the securities constituting it. It basically involves the simultaneous purchasing of a stock (most commonly a financial index) and a put written on it. The value of this portfolio at maturity is always greater than the strike of the put, no matter the market fluctuations and therefore this strike price is the insured amount, often equal to a prearranged percentage of the initial investment. This method of portfolio insurance is, however, often costly and inflexible and therefore many investors have, in recent times, turned to more transparent portfolio insurance strategies involving the movement between risky assets and cash, most commonly CPPI.

This paper focuses on these various rebalancing or dynamic asset allocation strategies, namely Stop-Loss and Lock-In strategies, which result in liquidation of the portfolio once a threshold is reached, a Constant Mix strategy requiring a constant asset allocation in an investor's portfolio and a Constant Proportion Portfolio Insurance (CPPI) strategy; with and without a ratchet lock-in approach, involving the constant rebalancing of an investor's asset allocation dependant on current market performance.

2.3 Capital Protection Strategies

2.3.1 Constant Proportion Portfolio Insurance

2.3.1.1 CPPI Composition

Black and Jones (1987) designed the CPPI strategy as an alternative to the complicated yet more established methods of Option Based Portfolio Insurance such as the costless collar strategy. This new method of portfolio insurance was based on the assumption that an investor's portfolio consisted of both a risky asset and a risk-free asset and this proportion is rebalanced continually to maintain a constant level of risk exposure and guarantee a predetermined floor. CPPI is designed so as to adjust to its weightings between the two asset classes, where in times of Bullish markets it is more heavily weighted in the risky asset (ALSI), while in Bearish markets it is more heavily weighted in the risk-free asset such as cash (Black and Perold, 1992).

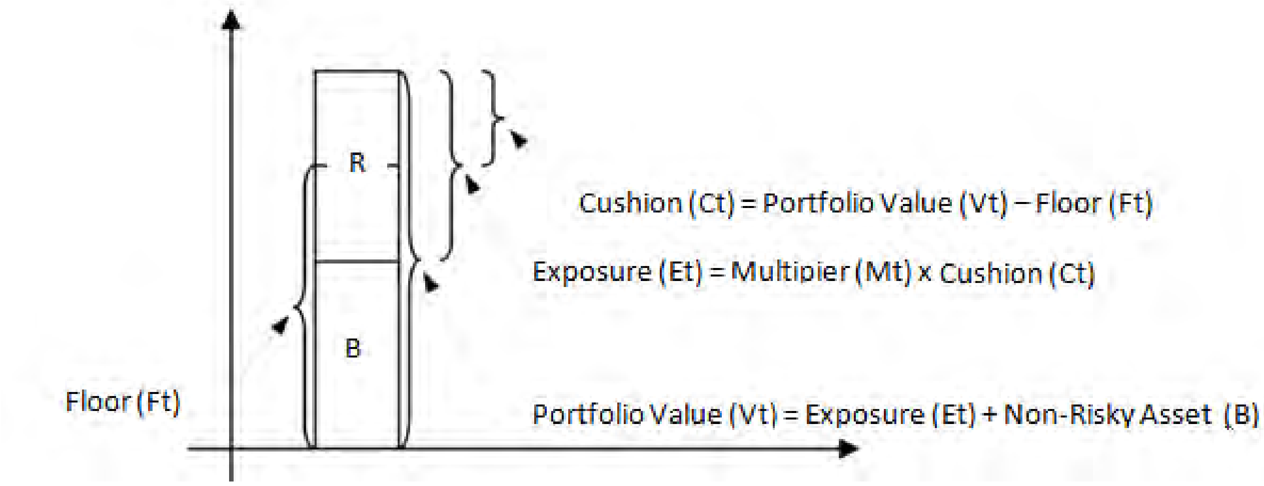

Figure 2.2

The composition of the CPPI strategy, shown in figure 2.2 above, is fairly straight forward. The floor at a point in time t, denoted throughout this paper as (F_t), is the minimum value of the portfolio that an investor will accept at the end of a given time period or maturity. This value can be either, simply a percentage of the initial investment or in addition a percentage of the initial investment with the ability to grow at the interest rate over the following periods thereby protecting the investor against downside risk as well as providing growth opportunities by allowing gains to be locked in. The value of the entire portfolio at a time t, denoted V_t, is invested in both a risky asset denoted by R and a non-risky (risk-free) asset denoted by B. This proportion invested in S varies in order to maintain the guaranteed floor.

The difference between the entire portfolio value and the floor value is called the cushion (C_t) and is defined as the maximum loss allowed on the investment before the principal amount is reached.

Cushion (C_t) = Portfolio Value (V_t) – Floor (F_t)

It must be noted here that the cushion and the floor are not amounts invested in certain asset classes but rather mechanisms to determine the allocation between the two asset classes and therefore subject to gap risk (Pain & Rand, 2008). This is the risk inherent in the strategy, as well as the others tested, that the guarantee/floor will be breached before the necessary rebalancing has taken place as result of a large and swift drop in the market.

The ratio between the cushion and the amount invested in the risky asset corresponds to the multiplier, denoted in this paper as M_t. This multiplier indicates the maximum level of exposure of the portfolio and is an indication of the risk aversion of the investor. It is more easily defined as the proportion invested in the risky asset (leverage indicator) and therefore is linearly related to both potential gains as well as potential losses. The exposure at a point in time t is denoted E_t and is the amount invested in the risky asset. It is fully dependant on the value of the multiplier, hence a larger multiplier results in greater exposure leading to greater upside potential but associated with more risk.

Exposure (E_t) = Multiplier (M_t) x Cushion (C_t)

After determining the amount invested in the risky asset using the multiplier and cushion effect above, the remaining amount is invested in the risk-free asset. These proportions are continually rebalanced through the use of algorithms explained in the methodology section of this paper.

CPPI has become a popular investment strategy or product among retail investors and more recently pension and insurance industries (Dichtl et. Al, 2010). This occurs due to the fact that these types of companies have to meet certain liabilities at specific future dates and thus have a high demand for securing future cash flows; a characteristic strongly associated with a CPPI strategy. CPPI products are typically offered to these businesses by investment banks traditionally as closed end products with a maturity of around 5 years and 100 percent principal guarantee. (Iversen et. Al, 2009)

2.3.1.2 CPPI Methodology

The rebalancing algorithms for both a traditional CPPI strategy as well as a modern version of the strategy which includes a ratchet reset approach are presented below. The method uses the same rebalancing algorithms implemented by Boulier and Kanninganti (2005).

Step 1

Calculate the Net Asset Value of the portfolio. This is equal to the initial allocation between both the risky and risk-free asset. An amount of R100 will be used in this paper as the initial portfolio value.

$$V_t = R + B$$

Step 2

Calculate the floor in order to determine the how to allocate the portfolio value between the risky and risk-free asset. Two methods can be used to calculate this floor value. Firstly, an investor may be guaranteed a principal amount or floor plus growth prospects, thus the floor is simply a discounted value of the principal. It can be defined as

$$F_t = P(1 + r)^{-T}$$

Where P represents the principal amount, r represents the risk-free rate and T shows the time to maturity of the strategy. It must be noted that the risk-free asset is not fully invested in proportion to the floor amount but rather dependant on the value. If the portfolio is not rebalanced into the risk-free asset quickly enough, the portfolio is subject to large gap risk and the guaranteed amount may not be met. The second and most popular way to calculate the floor value is by simply defining it as a proportion (ω) of the portfolio value and then allowing it to grow at the risk-free rate. This measure of calculating the floor value differs from the first, in the fact that the floor now grows to an unknown final value rather than a principal guaranteed amount.

$$F_t = \omega (V_t) \qquad 0 < \omega < 1$$

Step 3

After calculating the value of the floor, the cushion can be determined. Once again it is an allocation determining mechanism and not an actual amount invested. As defined earlier, the cushion is the difference between the portfolio value and the floor.

$$C_t = V_t - F_t$$

Step 4

Multiply the value of the cushion by the multiplier (M_t) to determine the amount invested in the risky asset (R). For instance a R100 portfolio with a cushion of R20 and a multiplier of 4 will have R80 invested in the risky asset.

$$R = M_t \ (C_t)$$

Step 5

After determining the amount to be invested in the risky asset, the remaining funds in the portfolio are invested in the risk-free asset (B).

$$B = V_t - R$$

Step 6

The portfolio is then constantly rebalanced on a monthly basis using the steps 1-5. For example, using the example in step 4, market events subsequently cause the risky asset to fall in value reducing the total portfolio value to R98. The floor, however increased at the risk-free rate and increases from R80 to R82 reducing the cushion to (R98 − R82) = R16. After rebalancing the amount invested in the risky asset is now down from R80 to

(R4 x R16) = R64. The decrease in the value of the risky asset results in a redistribution of portfolio value in favour of the risk-free asset.

2.3.1.3 *Variants of CPPI - Ratchet Modification Algorithm*

This modified version of CPPI allows an investor to put the excess cushion, created through a rise in the market, back into the floor. It is used as a result of the failure of a fixed floor growth rate to rise proportionately with the value of the portfolio and hence lose the leverage effect of the multiplier. It involves the restructuring of a floor value once a certain ratchet condition is met. This condition states that the floor be readjusted once the value of the investment in the risky asset (equity) is greater than a constant proportion of the portfolio value, namely the ratchet reset (α).

If the value invested in the risky asset exceeds this proportion, the floor is recalculated based on the proportion of risky asset that exceeds the ratchet reset. Since this investment in the index leverages its returns based on the multiplier, the floor is adjusted based on the proportion of excess leverage. This is simply based on a multiplier that has been adjusted for the weight of the portfolio that the manager does not want the risky asset to exceed ($\frac{M_t-\alpha}{M_t}$).

$$F_t{}^{new} = \frac{M_t - \alpha}{M_t}.V_t$$

If this new value for the floor does not exceed the original value growing at the risk-free rate (r), then it remains at this original fixed growth rate. This ensures protection against a portfolio over weighted in equity in times of market downturns.

$$F_t = F_{t-1}(1 + r)$$

Both the CPPI strategy and the modified ratchet reset approach are tested using multipliers to the value of 1.5; 2; 2.5 and 3. In addition, floor values of 60, 70, 80 and 90 are used while the ratchet approach incorporates reset proportions ranging from 0.5 to 0.8.

2.3.2 Stop-Loss and Lock-In strategies

A Stop-Loss arrangement can be thought of as a simple CPPI strategy whereby an investor selects an investment horizon over which cumulative performance must not violate a pre-specified floor. Once this floor or trigger point is breached, all risky assets are sold and the proceeds invested into the risk-free asset. For instance, a portfolio with R100 invested in the risky asset and a trigger point of 10% will have to invest all funds in the portfolio into the risk-free asset once the portfolio value decreases to R90. All future profit opportunities in the stock market are forgone due to the fact that the investor has to remain completely invested in the risk-free asset in order to ensure, like with CPPI, that a guaranteed value is met at the end of the planned period. A Stop-Loss of 100% would equate to a buy and hold strategy where an investor would always be invested in the risky asset.

Similarly, a Lock-In arrangement can be used to reduce risk by locking in upside gains. This is a process whereby an investor liquidates his portfolio's position in risky assets once a target level of appreciation is reached, in doing so, exchanging an uncertain return over the final part of a year for a known risk-free rate.

It is important to note that both a Fixed Percentage ("Fixed Rate") Stop-Loss strategy and a Rolling Average Stop-Loss strategy are implemented as opposed to simply a Fixed Rate Lock-In strategy detailed above. The difference between the two is that in a Rolling Average Stop-Loss, the trigger point does not apply to a certain percentage below the original portfolio value. Instead, it applies to the average return in previous months. For example, suppose a 5% threshold is chosen in a Rolling Average Stop-Loss strategy. The portfolio would be reinvested into the risk-free asset once the average return over a specified period decreases below 5%. Note that this strategy is also different in the manner in which it allocates capital back towards the risky asset. While the Fixed Percentage Stop-Loss strategy is implemented at different periods of the year and has a set maturity date stipulating when the portfolio is to be fully re-invested back into the Risky asset, the Rolling Average Stop-Loss reinvests into the risky asset once the rolling average is once again positive. The rolling nature in determining this average allows for the portfolio to thus only be re-invested into the Risky asset once a recovery in the equity market is well underway.

The Fixed Rate Stop-Loss and Lock-In strategies are both tested using maturities of 12 months and 24 months. Upon maturity, a new strategy is implemented, thereby locking-in the gains or losses of the previous year. In addition, these Fixed Rate strategies are analysed with implementation dates beginning both at the beginning of the calendar year, in January, as well as in July in order to determine whether there is notable outperformance of strategies employed at different times of the year. The Rolling Average Stop-loss strategy is tested using the average returns over a 3 month, 6 month, 12 month, 18 month and 24 month period. The Stop-Loss approaches are analysed using trigger points ranging from -35% to -5% using intervals of 5%, while the Lock-In approach uses trigger points ranging from 5% to 35%, once again in 5% intervals. Note that at these specified points, the portfolio is completely rebalanced from 100% invested in the risky asset to 100% invested in the risk-free asset.

2.3.3 Constant Mix

A Constant Mix strategy is implemented when an investor decides on the proportion of certain asset classes in his portfolio and constantly rebalances between these assets, notably a risky and risk-free asset in this paper, in order to keep the initial proportion constant. For example, an investor may have a portfolio consisting of 60% invested in equities and 40% in bills and rebalances to this proportion regardless of his individual wealth or potential performance of the equity market. The amount invested in stocks can be shown as

Target investment in stocks = m x Portfolio value

where the target proportion invested in stocks is represented by a constant term m. If the stock values increase, the proportion invested in the equity market naturally increases, but is quickly adjusted back down to m. The opposite occurs if there is a decrease in the market. For example, let's look at an investor who is running a 60/40 constant mix portfolio. That is, R60 of the portfolio value is invested in the risky asset and R40 is invested in the risk-free assets. If the value of the risky asset declines by 10%, the risky asset drops to R54 in value and the entire portfolio to R94. The proportion of risky assets in the portfolio is now 54/94 =

57.4%. This is lower than the chosen proportions. In order to get back to 60/40 mix, an investor will purchase R2.4 (56.4/94 = 60%) more of the risky asset. If the stock market had gone up, the investor would have done the opposite and sold some portion of the risky asset.

A Constant Mix strategy, similar to CPPI, attempts to create stable portfolio systematic risk over time, yet the dynamics behind the strategy are the complete opposite. While CPPI involves the purchase of stocks in an upward market and sale in a downward market, Constant Mix involves the move towards risk-free assets in a bullish market and the opposite in bearish times and hence effectively represents the sale of portfolio insurance leading to less downside protection than, and not as much upside as other portfolio protection methods.

The Constant Mix strategy is tested using target proportions invested in the risky asset and risk-free asset of 40:60; 50:50; 60:40; 70:30 and 80:20 respectively. In addition, the optimal rebalancing frequencies are analysed with monthly, quarterly, semi-annually and annually rebalancing of the portfolio towards the predetermined asset allocations.

3. PRIOR RESEARCH ON CAPITAL PROTECTION STRATEGIES

Ever since Black and Jones developed the first cash protection strategy involving the rebalancing of asset allocations amongst risky and non-risky investments in 1987, commonly known today as CPPI, considerable research has been conducted into the effectiveness and appropriateness of such portfolio insurance measures. Notably, however, is that most literature has centred around the comparisons between this CPPI approach and a synthetic put strategy (OBPI), while very little attention has been dedicated to the comparisons between the various dynamic asset allocation strategies mentioned in this paper.

Perold and Sharpe (1988) were the first to fully examine and compare different types of dynamic asset allocation strategies, namely CPPI, Constant Mix, Buy and Hold as well as OBPI. After analysing results in times of varying market conditions such as the bull and flat markets of the early 1980s, as well as the bear market of 1987, they suggest that no one type of strategy is dominant in all cases. Constant Mix is shown to underperform CPPI in both Bull and Bear markets, however, in times of trendless, volatile markets, it is a dominant strategy from a risk-return basis. They conclude that it is more important for financial analysts to help investors understand the unique implications of each strategy. In similar literature, Cesari and Cremonini (2003) tested the same four strategies as well as an added technical rule, with various stop-loss methods. They include 8 measures for calculating risk, return and risk adjusted performance, namely mean return, Standard Deviation, asymmetry, kurtosis, downside deviation, Sharpe ratio, Sortino ratio and return at risk and, similarly to Perold and Sharpe (1988), test these strategies in times of varying markets conditions. Interestingly, after using Monte Carlo simulations[2] to test these strategies, they find that a CPPI approach is preferable in bear markets and flat markets while a Constant Mix approach is dominant in bull markets as well flat markets with high volatility.

Do and Faff (2004) conducted simulations of these various strategies, but contributed a futures-based CPPI method based on stocks as well as SPI futures. In addition, their research included fine-tuned algorithms allowing for dividend payments, the consideration of ex ante volatility information and more up to date data than its predecessor and concluded that

[2] Monte Carlo simulation is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making.

their futures-based CPPI method of portfolio insurance dominated other index and bill insurance strategies from a floor protection perspective, mainly due to the lower transaction costs experienced in the futures market.

Surprisingly, most research, such as that conducted by Perold and Sharpe (1988), Cesari and Cremonini (2003) and Do and Faff (2004), has been constrained to downside risk measures such as Standard Deviation and downside deviation which are then compared after having altered the multiples in the various strategies to gain more exposure. For example, Boulier and Kannigant (1995) analysed various strategies based on the CPPI method of portfolio insurance. Using different values for both the multiplier, they concluded that the leverage effect of the multiplier is perhaps not as advantageous from a returns perspective under realistic assumptions as initially expected. In addition, they introduced a 'ratchet' strategy into their analysis which simply increased the floor value of the portfolio at a higher rate than the risk-free rate if equity returns were performing well, thereby guaranteeing gains made through the risky asset. This strategy, first suggested in 1988 by Estep and Kritzman, is commonly used today as a slight extension of the CPPI strategy and is often referred to as Time Invariant Portfolio Protection (TIPP). They concluded that, although this strategy possesses the ability to lock-in profits, it could end in the portfolio being underinvested in the risky asset.

It was only as recently as 2009, that Hamidi and Maillet (2009) proposed an alternative to this multiplier technique of comparing strategies. In their research they proposed, for the first time, the use of Value at Risk as a risk measure for evaluating a CPPI strategy. By determining a conditional multiple in order to keep the risk exposure constant and only dependant on market conditions, they evaluate the CPPI from VaR perspective and find promising results. Using both US stocks and French stocks they see evidence that that this new approach is extremely efficient with regards to monitoring the true risk exposure of such strategies.

Dimson and Marsh (2007) investigate the performance of an Option Based Portfolio Insurance strategy known as a Costless Collar as well as the more traditional cash approaches to risk management such as a Stop-loss strategy, a Lock-In strategy and a Constant Mix strategy. These conventional approaches have since been replaced by the more contemporary CPPI strategy, yet interestingly, according to Dimson and Marsh, little evidence supports the notion that this modern approach consistently outperforms its predecessors. One theory put forward by academics explaining this occurrence involves the January Effect, whereby stock prices tend to rise in January after a general decline in the market over the December period. This sell-off at the end of the year is believed to occur as a result of investors seeking to create a tax-loss in order to offset capital gains. Many investors, implementing a basic CPPI strategy at the beginning of January, may incur moderate losses at the end of the year, which are not felt by investors who, after implementing a Lock-In strategy, had already reached their target appreciation amount and liquidated their position in the market.

After analysing the strategies, using returns from the past 107 and 77 years on US and UK equity markets respectively, under varying volatility conditions, Dimson and Marsh concluded, however, that buying protection using the aforementioned strategies provides disappointing results in the long run when compared to a simple diversification strategy without protection. According to Dybvig (1988), this can partly be explained by the higher transaction costs involved in such strategies, providing evidence that investors are willing to surrender a portion of their potential gains in order to protect themselves against severe financial setbacks.

In another piece of the literature, Benninga (1990) uses simulation methods to analyze the properties of portfolio insurance strategies. Comparing different protection strategies, ranging from the OBPI to the, at the time, newly introduced CPPI strategy, Benninga documents that the simple Stop-Loss strategies tends to outperform these more complicated portfolio insurance strategies in terms of both the expected terminal wealth and the Sharpe-ratio. This notion, however, may have been heavily influenced by the time-period under analysis as shown by the research conducted by Bird and Cunningham (1990), who concluded that standard portfolio insurance strategies are robust to a variety of market conditions, including stock market crashes and hence may provide varying results as to which strategy provides greater risk- return trade-offs when evaluating different time periods.

In 2002, Binh Huu Do tested the relative performances of dynamic portfolio strategies using the Australian All Ordinaries Index (AAOI). The paper provides a comprehensive assessment of an Option Based Portfolio Insurance method (a synthetic put approach) versus a CPPI approach using different techniques such as daily rebalancing as well as trigger price rebalancing. Binh Huu Do finds that in the Australian market, a CPPI approach tends to dominate in terms of floor protection when the portfolio is constantly rebalanced while the OBPI methods provides higher returns using trigger prices. Most importantly, however, is the fact that the paper concludes that neither the OBPI method nor the CPPI method justify portfolio insurance practice from a loss minimizing and return maximizing perspective and hence recommend simply implementing buy and hold strategies in both asset classes.

In contrast, Dichtl & Drobetz (2010), when attempting to understand why so many investors prefer portfolio strategies or guaranteed financial products against other investment options, concluded that, contrary to previous studies, various alternative portfolio insurance strategies such as OBPI, CPPI and a Stop-Loss approach can be justified from a behavioural finance basis. This follows the common perception that most investors tend to be more risk averse and therefore the fear of loss outweighs the potential from an equal and opposite gain leading to an individual's preference for more costly but safer insurance options. Interestingly, when evaluating the various strategies individually, they find that the CPPI approach is preferable from a risk-return basis when employing both higher floor values and higher multiplier values, while the optimum Stop-loss approaches are preferred at protection levels of 90% and 95% (-10% and -5% trigger levels using Fixed Rate Stop-Loss).

Snorrason and Yusupov (2009) came to similar conclusions when evaluating the performance of both Traditional (Fixed Rate) Stop-loss and Trailing (Rolling Average) Stop-Loss strategies. Using daily returns the OMX Stockholm 30 index (OMXS) over an 11 year period from 1998-2009, they tested numerous trigger levels in order to find the optimum Stop-loss strategies. Their results indicate that that the use of a -10% trigger level when applying both types of Stop-Loss strategies is optimal from a risk-return perspective. Furthermore, they find that both Stop-Loss approaches outperform a simple buy and hold strategy in nearly all of the trigger levels tested, however, the use of large negative trigger levels (-30% and below) did not yield such positive results.

Most research around the optimum asset allocations to be employed when implementing a Constant Mix strategy agree on the fact that the optimal asset mix for an investor is the strategy that generates the highest level of expected utility. This utility is calculated by combining returns and volatility results, as explained in Modern Portfolio Theory, with a risk tolerance factor that is investor specific. (Reilly and Brown, 2012).

It is noticeable that, while literature on portfolio insurance involving the rebalancing of asset allocation is still growing, there is very little prior literature involving research from a South African perspective. Van Rensburg (2011) conducted a study, using both a CPPI approach and the modified ratchet approach, to ascertain an optimal strategy for portfolio protection over the past 45 years, whilst still maintaining the upside potential. The paper used various simulations, involving different parameter values of the multiplier and floor, in order to ensure robust analysis and develop an understanding of these factors effects on returns. The JSE All Share Index was used as a proxy for the risky asset, while the 90 days bankers' acceptance rate was used as a proxy for the risk-free asset. The paper indicates that the modified ratchet strategy offers far greater downside protection than the optimum CPPI strategy, however its overall performance, with regards to upside potential, falls short of its predecessor. Notably is the fact that the authors conclude that the modified ratchet strategy executed with optimal parameters is a viable and effective option for risk-averse investors seeking a financial product in the South African market.

While research on the performance of various Portfolio Insurance strategies remains somewhat inconclusive in its summation on which strategy provides better protection as well as returns potential, Iversen and Bilslev-Jensen (2009) conclude that there are three issues to look at when considering which one better may be better suited for different types of investors. Commitment, Transparency and Flexibility. The level of commitment of an investor generally has to be of a higher nature with regards to CPPI strategies as it is a "do it yourself" type strategy, involving constant rebalancing when compared to other approaches such as Stop-Loss or Lock-In strategy. In addition, cash re-balancing strategies tend to be more transparent when compared to option based strategies as they utilise traditional securities rather than complex products and are hence more attractive to private investors. Finally CPPI tends to be somewhat more flexible as each component in the strategy can be split up and traded at short notice as opposed to other strategies where an investor is forced to hold a product until maturity.

While the debate as to which dynamic asset allocation method provides the best results from a risk-return perspective, and whether it is justified in its use, remains heated, it is important to understand that the majority of the methods tested in this paper are concerned with the constant rebalancing of a portfolio between a risky and risk-free asset. While much research has gone into the need for portfolio rebalancing, there is scarce literature regarding its frequency. Arnott and Lovell (1993) were some of the few to address this issue and, after evaluating a portfolio implementing a Constant Mix strategy of 50% bonds and 50% stocks, they surmised that regular monthly rebalancing dominated less active approaches even after transaction costs had significantly reduced the rebalancing benefit. They were, though, unsure as to whether an even more active approach such as daily rebalancing provided better overall returns noting that increased costs such as taxes, time and labour costs as well as transaction costs could lead to decreasing returns.

Jaconetti et al. (2010) find contradicting results in the fact that their risk-adjusted returns are not meaningfully different whether adjusted daily, monthly, semi-annually or annually and therefore after taking the above costs into account, recommend using the latter two. In addition they recommend threshold rebalancing when the asset allocation or performance has drifted over a pre specified limit, specifying a 5% variation in the stock as an appropriate signal to switch. Interestingly, Van Weert (2010) analysed the relative performance of a Constant Mix strategy and a periodically rebalanced investment strategy. He found that as the time period between rebalancing decreases, periodically rebalanced strategy's performances move towards the corresponding constant mix strategy's performance. In other words, continually rebalancing ones portfolio on a daily basis can, in fact, be limiting when compared to a more periodic rebalancing strategy. Van Weert did, nevertheless, conclude that a constant mix strategy outperforms its corresponding periodically rebalanced strategy.

Jones and Stine (2005), however, analysed the optimal frequencies around rebalancing a constant mix strategy and concluded that the less frequently investors revise their portfolios, the more likely their portfolio are to drift relative to their target weights and chosen level of risk aversion. Investors who are more risk seeking are therefore less sensitive to a change in portfolio weights and would prefer quarterly, semi-annually and annual rebalancing (periodic rebalancing) as opposed to more risk averse investors who favour constant rebalancing of the portfolio.

With regards to the use of proxies as the different asset classes, prior research, notably Van Rensburg (2003), involving the utilisation of a risky asset in a South African context, has tended to use the JSE All Share Index as a proxy for the risky asset which is expected to yield high equity returns, while a 3 month T-Bill is favoured as the risk-free asset and, acting as the insurer, offers an acceptable low-level of returns.

4. DATA & METHODOLOGY

The following research data and methodology has been used to examine the various capital protection strategies and in turn provide insight into the practicality of their use. It is noteworthy that this paper is an analysis of a realized scenario and therefore there is no need to conduct simulations, as seen in Option Based Portfolio Insurance analysis, since prices are known. An absolute value of 100 will be used as the initial portfolio value for each strategy.

4.1 Sample selection

The primary data for this study was collected from the Datastream financial database.

4.1.1 FTSE/JSE Africa All Shares Index (ALSI)

The FTSE/JSE Africa All Shares Index (ALSI) has been used as a proxy for the equity or risky assets in the strategies tested. The ALSI is a market capitalization weighted index and includes companies that make up the top 99% of the full market capital value of all ordinary securities listed on the main board of the Johannesburg Stock Exchange. The investability weighting is the amount of shares that are freely available to investors and does not include those shares where shareholding is limited to specific individuals or institutions. 164 of the leading securities listed on the JSE are included in the ALSI. Data has been collected from the period January 1961 to August 2014 and therefore the index is rebased at 100 from the beginning of this period. Due to prior research supporting the notion of monthly rebalancing intervals as well as the extended length of the time period analysed, monthly returns on the index will be used to calculate the returns on the risky asset.

The interest rate used as a proxy for the risk-free rate is the 3 month Treasury Bill yield. These South African debt instruments are sold at discount to par and carry no coupon.

4.1.2 Bias in ALSI

The use of the FTSE/JSE Africa All Shares Index as a proxy for the risky asset may not provide a true reflection of the performance of the equity market due, mainly, to two indices biases.

Firstly survivorship bias, the tendency for failed companies to be excluded from performances studies as they no longer exist in the index, leads to positive Skewness in the returns results and therefore provides an over estimate of equity performance when compared to an individual investors actual stock portfolio. This may lead to capital protection strategies with greater weightings in equity, providing better results than actually observed. In addition, market inefficiency is believed to have the opposite effect on a market capitalization weighted indexes suitability as a proxy. This type of index weights the shares that make up the index by each share's market capitalization and is calculated as the number of shares in issue multiplied by the price of each share. However, it is based on a key assumption that markets are efficient and the price of share reflects its true value. If markets are in fact inefficient, as many believe them to be, some shares will undoubtedly be under-priced (cheap) and others may be over-priced (expensive). The market capitalization of a share is, nonetheless, determined by its price and will therefore have a larger allocation towards the more expensive, overvalued shares. In theory, if markets are mean reverting and tend toward their true value over time, the index would be sub-optimal as expensive shares would have a higher allocation but lower returns and therefore underperform an individual investor's stock portfolio.

4.1.3 Transaction Costs

Prior research provides evidence that transaction costs play a small role in determining the effectiveness of each strategy. Costs associated with constant rebalancing, as seen in both CPPI and Constant Mix strategies, may slightly reduce risk adjusted returns, however the comparative nature of this study leads us to assume that these costs will not materially alter our conclusions and hence transaction costs will not be included in this paper, both explicit; such as brokerage commissions, taxes and market fees, and implicit; such as the bid-ask spread.

4.2 Data Analysis

4.2.1 Statistical Measures

6 statistical measures have been used to analyse the performances of the various strategies from both a risk and return basis.

4.2.1.1 Geometric Mean Annual Return

$$\sqrt[n]{\frac{End\,Value}{Original\,Value}} \quad or \quad \sqrt[n]{(1+x_1)\times(1+x_2)\ldots\times(1+x_n)}-1$$

where n = Number of periods

x = Portfolio Return

The Geometric mean is a statistical measure indicating the central tendency or average value of a set of numbers by using the product of their values, unlike the arithmetic mean which uses their sum. The geometric mean is defined as the nth root of a product of n numbers. The Geometric Mean Annual Return was calculated using monthly intervals, therefore in order to annualize the results, the nth root is divided by 12 (the number of months in the year).

4.2.1.2 Standard Deviation of Returns

$$\sqrt{\frac{\sum(x-u)^2}{n}}$$

where n = Number of Periods

x = Portfolio Return

u = Mean Portfolio Return

Standard Deviation is a statistical measure indicating the volatility or robustness in returns of a certain strategy and therefore is often used as an indicator of risk. It is defined as the square root of the sum of the average squared deviation from the mean. This measure is of extreme relevance for this paper, as the aim is to find a suitable strategy experiencing low Standard Deviation and therefore producing more certain returns. Once again, in order to annualize the results, the equation must be multiplied by the square root of 12.

4.2.1.3 Sharpe Ratio

$$\frac{R_P - R_{rf}}{\sigma_p}$$

where R_P *= Portfolio Return*

R_{rf} *= Risk-free Rate of Return*

σ_p *= Standard Deviation of Portfolio Returns*

The Sharpe ratio, also known as the reward-to-variability ratio, measures the excess return (or risk premium) per unit of deviation in an investment. Simply, it shows how well an asset compensates an investor for the extra risk taken. When comparing two assets, the one with the higher Sharpe ratio provides higher returns for a given level of risk. Developed by William Sharpe in 1966, this risk-return measure has become one of the most popular methods for analysing fund manager performances around the world.

4.2.1.4 Skewness

$$\frac{\sum(\frac{x-u}{\sigma_p})^3}{n}$$

where n *= Number of Periods*

x *= Portfolio Return*

u *= Mean Portfolio*

σ_p *= Standard Deviation of Portfolio Returns*

Skewness, defined as the average cubed deviation from the mean divided by the Standard Deviation cubed, is a measure of the extent to which a probability distribution of a real-valued random variable "leans" to one side of the mean. For instance, a positively skewed distribution indicates a larger possibility of higher returns and lower possibility of large negative returns. The opposite occurs when the return distribution is negatively skewed. A positively skewed distribution of returns is preferred when evaluating the cash protection strategies as it minimizes the downside risk. A 12 month rolling average of portfolio returns is used to calculate annual Skewness.

4.2.1.5 Kurtosis

$$\frac{\sum(\frac{x-u}{\sigma_p})^4}{n} - 3$$

where n = Number of Periods

x = Portfolio Return

u = Mean Portfolio

σ_p = Standard Deviation of Portfolio Returns

Kurtosis, defined as the average of the fourth deviation from the mean divided by the Standard Deviation to the power of 4 minus 3, is a measure of the "peakedness" of the probability distribution of a real-valued random variable. A standard normal distribution has a kurtosis of zero while a distribution with excess kurtosis above zero, commonly known as leptokurtic, will have a pointed peak and longer tails, indicating a greater chance of experiencing an extreme outcome (greater risk). A return distribution with kurtosis below zero, commonly known as platykurtic, will as a result produce fewer extreme outcomes and hence be preferred by investors looking to minimize the risk in their portfolio.

4.2.1.6 Drawdown Analysis

$$\frac{V_t - Max\ (V_0 - V_{t)}}{Max\ (V_0 - V_t)}$$

$$where\ V_0 = Original\ portfolio\ value$$

$$V_t = Current\ portfolio\ value$$

A drawdown analysis measures the peak-to-trough decline of an investment, commodity or fund during a specific record period and is usually quoted as a percentage of portfolio value. It is an indicator of the total loss in value from an earlier peak or maximum point, which in times of extreme market crashes can completely wipe out an investment. An investor looking to minimize downside risk would prefer a lower drawdown, as it indicates less proportionate loss in portfolio value during market downturns and therefore a safer asset. Portfolio insurance aims to reduce this drawdown effect and in turn forgo upside potential in times of increased market sentiment.

5. RESULTS

This section discusses the core findings of the paper which are roughly compartmentalized into three parts. Firstly the results of the 6 strategies tested as well as the performance of a straight ALSI investment are shown. Strategies tested include a Fixed Rate Stop-Loss strategy, a Rolling Average Stop-Loss strategy, a Lock-In strategy, a Constant Mix strategy and a CPPI strategy, with an without a Ratchet mechanism. The performance of these strategies are evaluated individually using numerous variables in order to determine the optimal outcome under each approach.

Secondly, the various protection strategies are compared against one another with the aim of finding the ideal approaches to be used when implementing cash protection investment tools for both risk averse and risk seeking investors.

Finally, the optimum sub-strategies identified from each of the 6 approaches tested are evaluated. These findings are analysed over two sub-periods, from January 1961 to December 1987 and from January 1988 to August 2014 as to encompass the radically transformed investment landscape of South Africa.

5.1 Analysis of Individual Strategies

Variations of each of the Six Cash Protection strategies are defined as ‘sub-strategies’. Mean Annual Return (“Mean”), Standard Deviation of returns (“Std dev”), Sharpe ratio, Skewness, Kurtosis, Maximum Drawdown (“Max Drawdown”) and Maximum Annual Loss (“Max Annual Loss”) are used to analyse each sub-strategy. Note that all sub-strategies that outperform a pure diversified asset strategy (ALSI) on a risk-return (Sharpe ratio) basis are shown in light blue, while optimum sub-strategies of each approach are shown in dark blue.

5.1.1 FTSE/JSE Africa All Shares Index (ALSI)

Table 5.1: Analysis of returns of pure ALSI investment

ALSI	
Mean	18.1%
Standard dev	20.8%
Sharpe ratio	0.52
Skewness	0.39
Kurtosis	0.67
Max Drawdown	-57.91%
Max Annual Loss	-47.55%

The FTSE/JSE Africa All Shares Index (ALSI), which is used as the proxy for the risky asset, is also used as a benchmark for comparing the various strategies. While the ALSI shows exceptionally high returns over the 55 and a half year period (18.1%) Mean Annual Return, the lack of downside protection accompanying the risky asset leads to an even higher Standard Deviation of returns (21%). The Sharpe ratio of 0.52 indicates a reasonably high risk to return performance if investing purely in the ALSI. This may be incentive enough to pursue a diversification strategy in purely the equity markets (The ALSI represents 99% of the JSE market capitalisation) as opposed to a rebalancing protection strategy involving the use of a risk free asset.

Notably, we have differentiated between a Maximum Drawdown calculation and a Maximum Annual Loss. Whereas the Maximum Drawdown calculation provides us with a measure to determine the maximum peak to trough decline in an investment (and hence the maximum variation in your portfolio over the entire sample period), it fails to provide insight into the actual loss experienced in a predetermined period. The Maximum Annual Loss statistic above shows the greatest 12 month loss experienced by an investor who was 100% invested in the ALSI. Interestingly, the loss amount of 47.55% was experienced in the 12 months between June 1, 1969 and May 31, 1970. This stock market crash was not a result of contagion spread from declining international markets but simply a massive correction of an overvalued market – the JSE's average PE ratio was 26 times.

5.1.2 Fixed Rate Stop-Loss Strategy

Table 5.2: Analysis of individual Fixed Rate Stop-Loss strategies

The Fixed Rate Stop-Loss strategy is tested using maturities of 12 months and 24 months. Upon maturity, a new strategy is implemented, thereby locking-in the gains or losses of the previous year. These strategies are analysed with implementation dates beginning in January and in July. Trigger points ranging from -35% to -5% are tested at intervals of 5%. If the original portfolio value decreases to below these trigger levels, the portfolio is rebalanced into the risk-free asset.

6 months

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	17.76%	17.71%	0.56	0.81	1.16	-47.77%	-30.73%
-10%	18.00%	18.79%	0.55	0.80	1.34	-42.07%	-31.74%
-15%	16.95%	19.94%	0.48	0.60	1.01	-53.01%	-47.24%
-20%	17.91%	17.91%	0.52	0.58	0.99	-53.01%	-47.24%
-25%	17.76%	20.55%	0.51	0.45	0.78	-57.91%	-47.24%
-30%	18.07%	20.80%	0.52	0.39	0.67	-57.91%	-47.24%
-35%	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.24%

12 months Implemented in January

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	14.59%	17.06%	0.40	0.77	1.19	-45.26%	-39.29%
-10%	14.26%	18.52%	0.36	0.51	0.53	-47.20%	-41.44%
-15%	15.07%	19.53%	0.39	0.33	0.36	-53.75%	-47.55%
-20%	17.25%	20.19%	0.49	0.31	0.44	-53.75%	-47.55%
-25%	16.86%	20.29%	0.47	0.26	0.41	-58.33%	-47.55%
-30%	16.72%	20.42%	0.46	0.26	0.37	-57.91%	-47.55%
-35%	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

24 months Implemented in January

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	13.67%	15.29%	0.37	0.69	1.03	-43.86%	-40.08%
-10%	13.07%	17.24%	0.31	0.62	0.90	-48.01%	-40.08%
-15%	15.61%	18.93%	0.43	0.47	0.69	-45.58%	-39.65%
-20%	17.08%	19.85%	0.49	0.33	0.37	-47.51%	-41.78%
-25%	16.79%	20.17%	0.47	0.29	0.36	-53.75%	-47.55%
-30%	16.70%	20.32%	0.46	0.24	0.39	-58.33%	-47.55%
-35%	18.08%	20.71%	0.52	0.37	0.70	-58.33%	-47.55%

12 months Implemented in July

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	17.78%	16.67%	0.58	1.22	2.32	-30.31%	-26.72%
-10%	17.46%	17.50%	0.54	0.99	1.59	-33.71%	-26.72%
-15%	16.92%	18.37%	0.50	0.72	0.99	-44.86%	-33.51%
-20%	17.16%	18.87%	0.50	0.63	0.96	-47.40%	-33.51%
-25%	17.38%	19.42%	0.50	0.48	0.74	-45.03%	-39.65%
-30%	18.72%	20.26%	0.55	0.48	0.79	-45.03%	-39.65%
-35%	18.24%	20.61%	0.53	0.42	0.71	-53.29%	-47.55%

24 months Implemented in July

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	16.30%	14.20%	0.55	1.09	1.97	-30.31%	-21.35%
-10%	16.51%	15.06%	0.54	0.86	1.39	-41.10%	-24.82%
-15%	14.93%	16.52%	0.42	0.53	0.88	-61.41%	-33.51%
-20%	15.51%	18.00%	0.43	0.62	1.06	-62.99%	-33.51%
-25%	15.96%	18.78%	0.44	0.49	0.84	-51.00%	-39.65%
-30%	16.57%	19.65%	0.46	0.48	0.93	-51.00%	-39.65%
-35%	18.35%	20.59%	0.53	0.42	0.65	-58.35%	-47.55%

ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

Table 5.2 shows the results of a Fixed Rate Stop-Loss protection strategy implemented with various threshold rates that trigger a change from 100% of the portfolio invested in the risky asset to 100% in the risk free asset. When analysing the results, the most noteworthy inference is the large out performance of both a 12 month and 24 month Stop-loss strategy implemented in July over a strategy implemented in January with lower negative trigger points. A 12 month -5% January Stop-Loss [3] sub-strategy yields a Mean Annual Return of 14.59% and Standard Deviation of 17.06% compared to a Mean Annual Return of 17.78% and Standard Deviation of 16.67% observed in the 12 month -5% July Stop-Loss sub-strategy.

The risk to reward ratios are noticeably different with the former showing a modest Sharpe ratio of 0.4 compared to the latter's 0.58. Similarly a 24 month strategy beginning in January and July at this minimum threshold level yields Sharpe ratios of 0.37 and 0.55 respectively. Interestingly, both the Maximum Drawdown and the Maximum Annual Loss figures for the 24 month July sub-strategy are less than that of the both January sub-strategies further enhancing our conclusion that strategies that reset midway through the calendar year have a smaller probability of experiencing large negative outcomes. Figure 5.1 illustrates the Drawdown analysis of both the -5% 24 month January and July sub-strategies as well as the ALSI. It is evident that at lower negative trigger levels, such as -5%, a July Stop-Loss strategy significantly outperforms a similar strategy implemented in January.

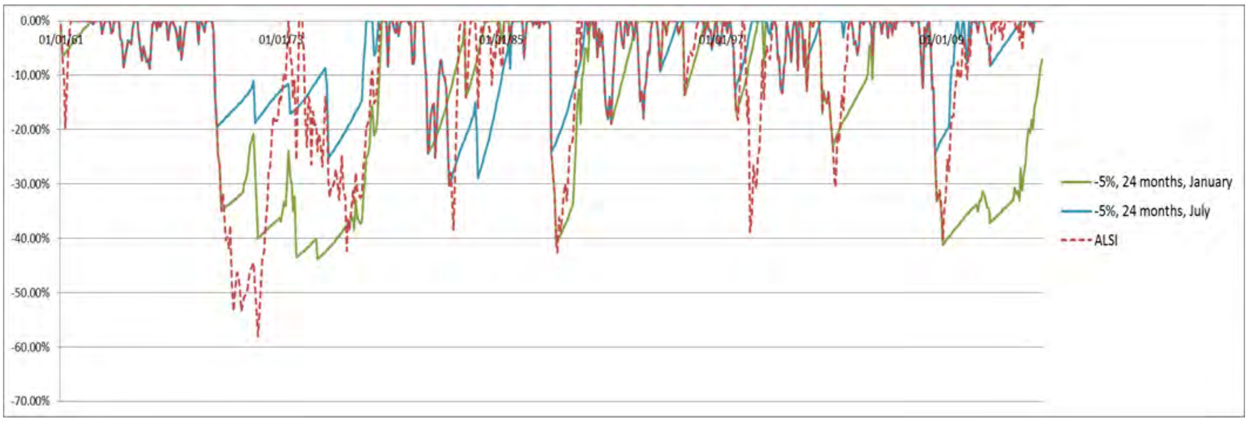

Figure 5.1: Drawdown Analysis of Fixed Rate Stop-Loss sub-strategies implemented in differing time periods

The 'Peak to Trough' results of a -5% 24 month January Fixed Rate Stop-Loss sub-strategy, a -5% 24 month July Fixed Rate Stop-Loss sub-strategy and pure ALSI strategy. Note that the portfolio is invested fully into the risk-free asset once the original portfolio value decreases by more than 5% within 24 months from implementation date. The portfolio is therefore still vulnerable to large drops in the share price as a result of gains made over the duration of the strategy.

[3] A 12 month -5% January Stop-Loss sub-strategy refers to a Stop-Loss strategy employed over 12 months with a rebalancing threshold of -5%, implemented at the beginning of January.

At higher negative trigger levels, such as -25%, the difference in performance between the two timing strategies is less extreme with Sharpe ratios ranging between 0.44 and 0.56. Maximum Drawdown and Maximum Annual Loss figures for sub-strategies at these higher trigger levels are noticeably different when implemented in different time periods which may be a result of sample bias. The fact that over 53 years of data was back-tested, however, leads us to accept the proposed theory that the use or partial use of a Fixed Rate Stop-Loss strategy beginning mid-year as opposed to at the beginning of the calendar year will increase portfolio performance from both a risk and return basis.

Evaluating the various approaches individually, it can be observed that the returns and Sharpe ratios of the strategies implemented in January increase as the negative threshold levels increase while those in July tend to show increased performance at both the extreme lower and higher thresholds, namely -5%, -10%, -30% and -35%.

A 12 month -30% July Stop-Loss sub-strategy yields the highest Mean Annual Return of 18.72%. This outcome is expected as it shows a similar return profile to that of a straight ALSI strategy. Alternatively, the 12 month -5% July sub-strategy yields the highest Sharpe ratio (0.58) out of all the Stop-Loss strategies tested. This return to risk payoff far exceeds the alternative of investing purely in the risky asset without a protection strategy. Furthermore, the sub-strategy's Skewness of 1.22 is the largest observed in our analysis indicating that downside risk is minimized. These factors combined with the lower Maximum Drawdown and Maximum Annual Loss results of 30.31% and 26.72% respectively lead us to endorse the 12 month -5% July Stop-Loss sub-strategy as the best from a risk return perspective.

Interestingly, a large majority of the strategies tested show a Maximum Annual Loss far greater than the rebalancing threshold. This is to be expected for three reasons. Firstly a Fixed Rate strategy is used as opposed to a Trailing Stop-Loss strategy. The latter differs in the fact that the rebalancing trigger is based on the highest portfolio value achieved as opposed to the original portfolio value. For example if a Trailing Stop-Loss was implemented with a trigger level of -5% and the portfolio loses more than 5% at any point in time, then the investor re-invests in the risk-free asset and hence locks in previous gains made. With a Fixed Rate Stop-Loss, the portfolio will lose all the gains made since the strategy was implemented and then a further 5% before being rebalanced into the risk-free asset and as a result, previous gains made in the year are not locked in.

Secondly, the Maximum Annual Loss figure is calculated on a rolling monthly basis. The results are therefore subject to the performance of two overlapping strategies in separate years. For example, if the portfolio was 20% above the Stop-Loss threshold with 6 months to go and loses the full 20% over the subsequent months, the Stop-Loss order is made and the portfolio is invested fully into the risk-free asset. Soon after, however, the portfolio is once again re-invested into the risky asset and subject to further losses until the rebalancing threshold is passed. Thus a portfolio can potentially lose 30% in a year based on the timing of the strategy implementation. This issue with the Stop-Loss strategy was one of the key rationale behind the development of the CPPI trading strategy with an increasing floor, according to Dichtl & Drobetz (2010).

The third explanation for the difference between the Maximum Annual Loss and the rebalancing threshold, which occurs in all six strategies evaluated, is explained by the occurrence of 'Gap risk' in our portfolio of returns. Returns of the proxy for the risky asset are calculated on a monthly basis in discrete time periods and hence the stop-loss strategies are, on occasion, only implemented once the portfolio value has decreased substantially below the rebalancing threshold. This factor is notably more predominant in times of large market downturns. Practically, it can be avoided through the constant monitoring of the asset returns and the immediate implementation of a Stop-Loss order. Under this assumption of a complete financial market where one trades in continuous time, it is known with certainty that the payoffs will outperform a pre-specified minimum wealth level.

5.1.3 Rolling Average Stop-Loss Strategy

Table 5.3: Analysis of individual Rolling Average Stop-Loss strategies

The Rolling Average Stop-Loss strategy is tested using the rolling average of returns as a trigger to rebalance a portfolio into the risky or risk-free asset. 3 months, 6 month, 12 month, 18 month and 24 month rolling averages are tested. Trigger points ranging from -35% to -5% are tested at intervals of 5%. The portfolio is reinvested into the risky asset once the rolling average return is again positive.

3 month Rolling Average

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	18.71%	17.14%	0.62	0.71	0.91	-48.36%	-29.31%
-10%	18.76%	18.01%	0.60	0.65	0.71	-48.60%	-32.87%
-15%	17.08%	19.38%	0.49	0.53	0.57	-51.06%	-36.88%
-20%	18.15%	19.73%	0.54	0.55	0.63	-48.60%	-41.11%
-25%	18.30%	20.54%	0.53	0.48	0.81	-57.91%	-52.58%
-30%	18.16%	20.56%	0.53	0.47	0.78	-57.91%	-52.58%
-35%	18.10%	20.80%	0.52	0.46	0.77	-57.91%	-52.58%

6 month Rolling Average

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	17.20%	17.74%	0.53	0.62	0.87	-50.19%	-38.51%
-10%	16.95%	18.37%	0.50	0.49	0.68	-57.72%	-41.84%
-15%	16.54%	18.65%	0.48	0.50	0.59	-51.30%	-43.38%
-20%	17.63%	19.48%	0.52	0.49	0.66	-46.80%	-33.27%
-25%	17.75%	19.75%	0.52	0.43	0.60	-46.80%	-38.43%
-30%	18.07%	19.98%	0.53	0.45	0.65	-42.28%	-38.43%
-35%	17.86%	20.73%	0.51	0.44	0.81	-57.91%	-52.58%

12 month Rolling Average

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	16.71%	17.67%	0.50	0.70	0.99	-40.89%	-36.11%
-10%	16.17%	18.52%	0.46	0.62	0.89	-40.89%	-36.11%
-15%	16.04%	18.71%	0.45	0.55	0.85	-50.73%	-39.43%
-20%	15.94%	19.05%	0.44	0.47	0.74	-50.73%	-39.43%
-25%	16.57%	19.82%	0.46	0.55	0.91	-52.47%	-41.58%
-30%	17.81%	20.25%	0.51	0.56	0.92	-52.47%	-41.58%
-35%	17.75%	20.35%	0.51	0.51	0.80	-52.47%	-41.58%

18 month Rolling Average

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	16.37%	18.56%	0.47	0.54	0.95	-42.51%	-39.15%
-10%	16.27%	18.76%	0.46	0.50	0.94	-42.51%	-41.58%
-15%	16.56%	19.28%	0.47	0.45	0.65	-48.53%	-48.53%
-20%	16.89%	19.36%	0.48	0.41	0.63	-48.53%	-48.53%
-25%	16.35%	19.49%	0.46	0.32	0.60	-53.46%	-52.58%
-30%	16.69%	19.77%	0.47	0.32	0.59	-53.46%	-52.58%
-35%	18.00%	20.46%	0.52	0.42	0.79	-53.46%	-52.58%

24 month Rolling Average

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
-5%	15.32%	19.06%	0.41	0.48	0.88	-48.53%	-48.53%
-10%	15.30%	19.17%	0.41	0.44	0.86	-48.53%	-48.53%
-15%	15.07%	19.39%	0.40	0.35	0.82	-53.46%	-52.58%
-20%	14.95%	19.41%	0.39	0.35	0.79	-53.46%	-52.58%
-25%	17.58%	20.09%	0.51	0.48	1.02	-53.46%	-52.58%
-30%	17.60%	20.19%	0.51	0.50	0.99	-53.46%	-52.58%
-35%	17.70%	20.52%	0.51	0.47	0.91	-53.46%	-52.58%

ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

Table 5.3 shows the results for a Rolling Average Stop-Loss strategy tested using 3 month, 6 month, 12 month, 18 month and 24 month rolling average of returns to determine the switch between the risky and risk-free assets. The results indicate a clear preference towards implementing a Stop-Loss strategy with rolling averages calculated over shorter time periods. All but one of the sub-strategies implemented using a 3 month rolling average show Sharpe ratios above 0.52, while strategies using 12 month and 24 month rolling averages yield far lower risk to reward ratios of 0.51 or below.

Notably, returns increase as Rolling Average duration decreases. A 3 month -20% RA Stop-Loss[4] sub-strategy yields a Mean Annual Return of 18.15% compared to a 24 month -20% RA Stop-Loss sub-strategy which yields a Mean Annual Return of 14.95%. Interestingly, at higher negative trigger levels, volatility also increases as rolling average duration decreases. This is to be expected with the higher level of returns witnessed. However, at lower trigger levels, volatility decreases as you move from a 24 month rolling average towards a 3 month rolling average. This anomaly promotes the use of lower trigger values when implementing a shorter rolling average duration and the opposite for longer rolling average durations. A 3 month -5% RA Stop-Loss sub-strategy yields a Standard Deviation of returns of 17.14% compared to a 24 month -5% RA Stop-Loss sub-strategy which yields a Standard Deviation of returns of 19.06%.

Maximum Drawdown and Annual Loss results are relatively consistent across all sub-strategies although with shorter rolling durations, there tends to be greater variation in the Maximum Annual Loss results. As expected lower trigger values are preferable in terms of cash protection.

[4] A 3 month -20% RA Stop-Loss strategy refers to a Rolling Average Stop-Loss strategy employed using a 3 month rolling average of returns with a rebalancing threshold of -5%.

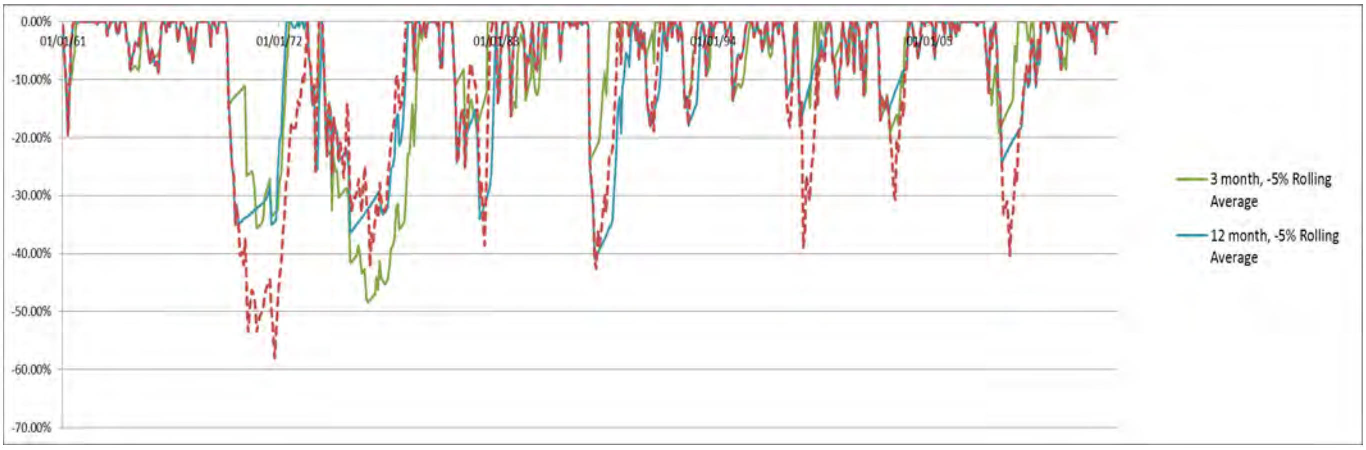

Figure 5.2: Drawdown Analysis of Rolling Average Stop-Loss sub-strategies with differing Rolling Average durations

The 'Peak to Trough' results of a 3 month -5% Rolling Average Stop-Loss sub-strategy, a 12 month -5% Rolling Average Stop-Loss sub-strategy and pure ALSI strategy. Note that the portfolio is invested fully into the risk-free asset once the Rolling Average decreases by more than 5%. The portfolio is re-invested fully into the risky asset when the Rolling Average is once again positive.

Figure 5.2 illustrates the drawdown analysis of both a 3 month and 12 month -5% RA Stop-Loss sub-strategy. While the 3 month RA sub-strategy shows the larger Maximum Drawdown figure, as seen in both Table 5.3 and Figure 5.2, the shorter duration Rolling Average sub-strategy displays, on average, improved cash protection performance over the entire sample period.

The strategy with the highest Mean Annual Return is the 3 month -10% RA Stop-Loss sub-strategy yielding an exceptionally high annual return of 18.76%. The optimum sub-strategy, however, from a risk-return perspective is the 3 month -5% RA Stop-Loss sub-strategy which yields a Sharpe ratio of 0.62 (along with a highly attractive Mean Annual Return of 18.71%). In addition, this strategy displays the highest Skewness figure (0.71) and lowest Maximum Annual Loss results (-29.31%) of all strategies tested.

5.1.4 Lock-In Strategy

Table 5.4: Analysis of individual Lock-In strategies

The Lock-In strategy is tested using maturities of 12 months and 24 months. Upon maturity, a new strategy is implemented, thereby locking-in the gains or losses of the previous year. These strategies are analysed with implementation dates beginning in January and in July. Trigger points ranging from 5% to 35% are tested at intervals of 5%. If the original portfolio value increases to above these trigger levels, the portfolio is rebalanced into the risk-free asset.

6 months

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
5%	11.77%	15.73%	0.25	-0.62	0.93	-50.61%	-45.74%
10%	14.84%	17.83%	0.40	-0.25	0.34	-45.74%	-45.74%
15%	16.57%	18.85%	0.48	-0.15	-0.06	-45.74%	-45.74%
20%	17.55%	19.65%	0.51	-0.13	-0.18	-50.93%	-45.74%
25%	18.09%	19.95%	0.53	-0.13	-0.23	-50.93%	-45.74%
30%	18.42%	20.07%	0.55	-0.01	-0.20	-50.93%	-45.74%
35%	18.53%	20.22%	0.55	0.05	-0.12	-50.93%	-45.74%

12 months Implemented in January

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
5%	13.13%	12.19%	0.38	0.28	4.98	-33.74%	-28.26%
10%	14.48%	14.41%	0.43	-0.08	2.07	-33.74%	-29.29%
15%	14.52%	16.10%	0.40	-0.07	1.49	-40.26%	-37.61%
20%	15.88%	17.41%	0.46	-0.03	0.88	-40.26%	-37.61%
25%	18.05%	17.96%	0.57	0.21	1.48	-40.26%	-37.61%
30%	19.14%	18.18%	0.62	0.21	0.84	-40.26%	-37.61%
35%	19.86%	18.69%	0.64	0.18	0.53	-40.26%	-37.61%

24 months Implemented in January

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
5%	11.23%	9.42%	0.27	1.69	12.10	-33.74%	-21.82%
10%	12.46%	11.35%	0.35	0.85	5.36	-33.74%	-21.82%
15%	13.91%	12.52%	0.43	0.85	5.18	-33.74%	-21.82%
20%	15.93%	14.38%	0.53	0.65	2.49	-33.74%	-21.82%
25%	17.43%	14.89%	0.61	1.01	4.97	-33.74%	-21.82%
30%	17.51%	16.26%	0.58	0.82	3.84	-38.87%	-29.77%
35%	17.46%	17.23%	0.55	0.43	2.71	-40.26%	-37.61%

12 months Implemented in July

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
5%	11.20%	13.62%	0.22	-0.56	2.03	-52.52%	-45.74%
10%	13.84%	15.57%	0.37	-0.31	2.10	-49.93%	-45.74%
15%	15.28%	16.82%	0.44	-0.55	1.08	-49.93%	-45.74%
20%	16.32%	18.03%	0.47	-0.53	0.36	-50.93%	-45.74%
25%	16.38%	18.83%	0.46	-0.44	0.07	-50.93%	-45.74%
30%	16.23%	19.53%	0.45	-0.28	-0.22	-50.93%	-45.74%
35%	16.19%	19.78%	0.44	-0.08	-0.16	-50.93%	-45.74%

24 months Implemented in July

Threshold	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
5%	10.28%	11.11%	0.17	-0.89	3.69	-50.93%	-45.74%
10%	11.99%	11.75%	0.30	-0.67	3.26	-50.93%	-45.74%
15%	11.85%	14.26%	0.26	-0.48	1.72	-50.93%	-45.74%
20%	12.63%	15.77%	0.30	-0.18	0.66	-50.93%	-45.74%
25%	13.13%	17.28%	0.31	-0.16	0.31	-50.93%	-45.74%
30%	12.97%	18.18%	0.30	-0.13	0.04	-50.93%	-45.74%
35%	13.56%	18.67%	0.33	0.02	0.40	-50.93%	-45.74%

ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

The results for the various Lock-In sub-strategies can be seen in Table 5.4. As expected the Lock-In strategy does not provide the necessary protection against downside risk. Maximum Drawdown figures are as high as 50.93% and Maximum Annual Losses are as high as 45.74% - only 1.81% below the Maximum Annual Loss incurred with a pure Risky asset strategy. This is due to the fact that the Lock-In approach aims to protect gains made in previous months as opposed to preventing large losses from being incurred from the date the strategy is implemented.

Analysing the two different timing strategies, beginning in either January or July, we find that, in complete contrast to our Fixed Rate Stop-Loss findings, the Lock-In approach is preferable when implemented in January as opposed to 6 months later in the calendar year. While, as highlighted with the Stop-loss strategies, these results may be subject to sample bias, there does appear to be overwhelming evidence substantiating this notion.

A 12 month 5% January Lock-In sub-strategy[5] yields a Mean Annual Return of 13.13% and Standard Deviation of 12.19% compared to a Mean Annual Return of 11.20% and Standard Deviation of 13.62% observed in the 12 month 5% July sub-strategy. The risk to reward ratios are noticeably different with the former showing a Sharpe ratio of 0.38 compared to the latter's 0.22. Similarly a 24 month strategy beginning in January and July at this minimum threshold level yields Sharpe ratios of 0.27 and 0.17 respectively. While these results indicate a notable difference in performance between strategies implemented in either January or July, they also show that Lock-In strategies using lower rebalancing thresholds do not offer an acceptable risk to reward payoff when compared to those strategies implementing higher rebalancing thresholds.

Table 5.4 shows that as the rebalancing threshold levels increase from 5% to 35%, both the Mean Annual Returns and the Sharpe ratios tend to increase as well. Only a 24 month January strategy and 12 month July strategy do not have maximum Sharpe ratios at the maximum rebalancing threshold level of 35%. At these higher trigger levels, strategies implemented in January, once again, outperform those implemented in July from both a risk return and a Maximum Annual Loss perspective. Sharpe ratios for both 12 and 24 month January sub-strategies with thresholds of 25% and above range between 0.55 and 0.64

[5] A 12 month 5% January Lock-In sub-strategy refers to a Stop-Loss strategy employed over 12 months with a rebalancing threshold of 5%, implemented at the beginning of January.

compared to those of July strategies of the same thresholds ranging from 0.30 to 0.46. In addition, Maximum Drawdown and Maximum Annual Loss results are considerably lower, with the 24 month January sub-strategies showing highly attractive results with regards to minimizing downside exposure. Figure 5.3 illustrates the Drawdown Analysis of a both the 25% 24 month January and July sub-strategies as well as the ALSI. It is evident that at higher trigger levels, such as 25%, a January Lock-In strategy significantly outperforms a July Lock-In strategy, which interestingly shows a similar drawdown path to that seen in a pure ALSI investment.

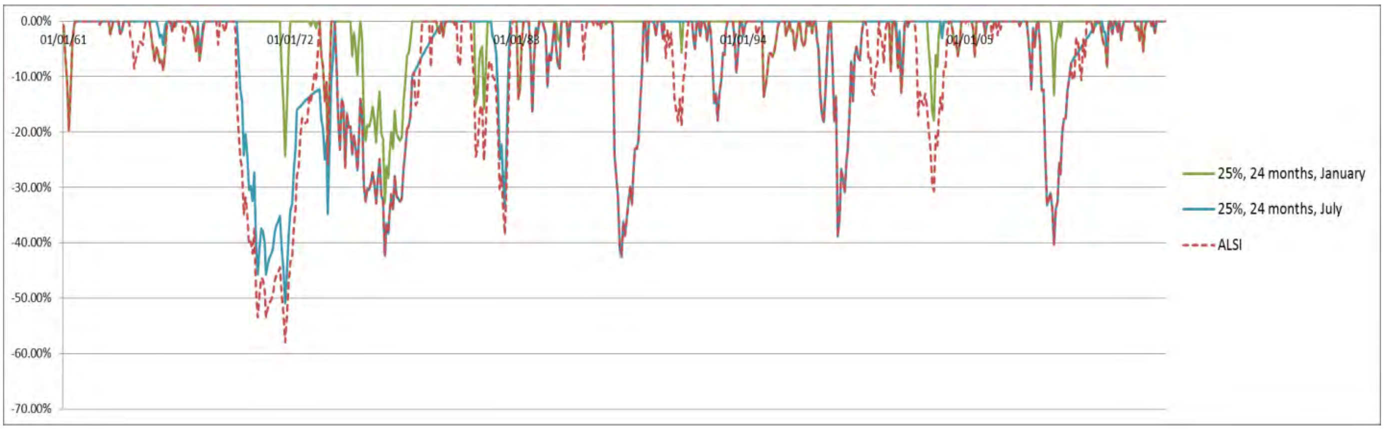

Figure 5.3: Drawdown Analysis of sub-strategies implemented in differing time periods

The 'Peak to Trough' results of a 25% 24 month January Lock-In sub-strategy, a 25% 24 month July Lock-In sub-strategy and pure ALSI strategy. Note that the portfolio is invested fully into the risk-free asset once the original portfolio value increases by more than 25% within 24 months from implementation date.

The individual sub-strategy with the both the highest Mean Annual Return (19.86%) and Sharpe ratio (0.64) is the 12 month 35% January sub-strategy, however, the high rebalancing threshold of 35% will, in most years, never be reached leading to a Lock-In approach resembling a pure risky asset strategy. For this reason, it is believed that the 24 month 25% January sub-strategy is the most attractive from a risk return perspective. With a Standard Deviation of returns of 14.89%, a Sharpe ratio of 0.61 and a Skewness of above one, the strategy provides investors with a more acceptable cash protection option. Furthermore it yields the lowest Maximum Drawdown and Maximum Annual Loss combination that can be achieved in all the Lock-In strategies analysed.

5.1.5 Constant Mix Strategy

Table 5.5: Analysis of individual Constant Mix strategies

The Constant Mix strategy is tested using target proportions invested in the risky asset and risk-free asset of 40:60; 50:50; 60:40; 70:30 and 80:20 respectively. In addition, the optimal rebalancing frequencies are analysed with monthly, quarterly, semi-annually and annually rebalancing of the portfolio towards the predetermined asset allocations.

Monthly rebalancing

Asset Allocation (Risky/Rf)	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
40/60	13.15%	8.33%	0.506	0.01	0.52	-23.02%	-19.72%
50/50	14.10%	10.40%	0.509	0.07	0.52	-29.79%	-25.02%
60/40	15.00%	12.47%	0.511	0.14	0.52	-36.40%	-30.04%
70/30	15.87%	14.55%	0.513	0.20	0.54	-42.48%	-34.79%
80/20	16.68%	16.64%	0.516	0.27	0.57	-48.08%	-39.29%

Quarterly rebalancing

Asset Allocation (Risky/Rf)	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
40/60	13.25%	8.37%	0.515	0.09	0.64	-23.05%	-19.96%
50/50	14.21%	10.44%	0.516	0.14	0.63	-29.64%	-25.25%
60/40	15.11%	12.51%	0.517	0.19	0.61	-36.27%	-30.25%
70/30	15.95%	14.58%	0.518	0.24	0.61	-42.37%	-34.97%
80/20	16.75%	16.66%	0.519	0.29	0.62	-48.00%	-39.41%

Semi-annual rebalancing

Asset Allocation (Risky/Rf)	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
40/60	13.29%	8.40%	0.517	0.24	0.85	-22.79%	-19.83%
50/50	14.24%	10.46%	0.518	0.26	0.81	-29.21%	-25.09%
60/40	15.13%	12.53%	0.519	0.29	0.77	-35.85%	-30.08%
70/30	15.98%	14.59%	0.520	0.31	0.73	-42.00%	-34.80%
80/20	16.76%	16.65%	0.520	0.34	0.70	-47.72%	-39.28%

Annual rebalancing

Asset Allocation (Risky/Rf)	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
40/60	13.20%	8.48%	0.504	0.08	0.39	-23.54%	-20.61%
50/50	14.14%	10.54%	0.507	0.14	0.45	-30.52%	-25.87%
60/40	15.04%	12.59%	0.510	0.20	0.48	-37.00%	-30.78%
70/30	15.89%	14.64%	0.512	0.25	0.51	-42.93%	-35.39%
80/20	16.69%	16.69%	0.515	0.30	0.55	-48.37%	-39.70%

ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

The Constant Mix strategy differs from both the Stop-Loss strategy and the Lock-In strategy in that the rebalancing of the portfolio does not involve the once off sale of all the risky assets and resultant purchase of risk-free assets. It simply involves portfolio rebalancing based on a pre-specified proportion of risky assets to risk-free assets. As monthly data has been used, it is assumed that a strategy with monthly rebalancing is a proxy for a pure constant mix strategy whilst periodic rebalancing results are shown under quarterly, semi-annual and annual rebalancing figures.

Table 5.5 shows the results for various Constant Mix sub-strategies tested over the period January 1961 to August 2014. Importantly five different asset allocation proportions are tested with different rebalancing time intervals. As expected, there is little variation in the results of the different strategies based on different rebalancing periods. As the asset allocation moves towards a greater proportion invested in the risky asset, portfolio returns and risk increase along with the downside potential illustrated by the Maximum Drawdown and Maximum Annual Loss results in Table 5.5. Sharpe ratios range between 0.504 and 0.52 indicating a consistently attractive risk to reward payoff inherent in a Constant Mix strategy.

What is evident, however, is that Constant Mix strategies that are periodically rebalanced on a semi-annual (six month) basis yield both the highest Mean Annual Returns and Sharpe ratios for all asset allocations tested. These findings are consistent with Van Weert's (2010) conclusion that periodically rebalanced portfolios tend to outperform a constantly rebalanced portfolio. Importantly, transaction costs have not been taken into account in our results. The inclusion of such costs would lead to a decrease in returns and hence decrease in Sharpe ratios for strategies that are rebalanced more regularly such as the monthly and quarterly rebalancing strategies. This further validates our inference that periodically rebalanced portfolios will outperform constantly rebalanced portfolios with a preference towards using six month time periods.

Evaluating the strategies individually, it can be observed that two sub-strategies are optimal from a risk return perspective. Both a 70/30[6] and 80/20 strategy with semi-annual rebalancing exhibit Sharpe ratios of 0.52. While the 80/20 strategy shows both higher Mean Annual Returns and Skewness, the 70/30 strategy has a lower Maximum Drawdown and Maximum Annual Loss result highlighting a more effective cash protection approach. These Maximum Drawdown and Annual Loss results seem to contradict the notion that a more positively skewed distribution of returns is preferred when evaluating the cash protection

[6] A 70/30 strategy refers to a Constant Mix strategy with 70% invested in the risky asset with the remaining 30% invested in the risk-free asset.

strategies as it minimizes the downside risk. As can be seen in Table 5.5, the riskier investment sub-strategies yield a higher Skewness. One would expect a risky investment that yields a higher positive Skewness to exhibit excess Kurtosis as the frequency of large positive and negative outcomes would increase (large peak and fat tails). One possible explanation is that the Maximum Drawdown and Maximum Annual Losses are simply worst case scenarios as opposed to Skewness and Kurtosis which are calculated based on the entire distribution of returns. Nevertheless, the results observed do warrant the need for further research to be conducted into the usefulness of Skewness and Kurtosis when evaluating investment risk.

Figure 5.4 provides an illustration of the drawdown analysis of Bi-annually rebalanced Constant Mix strategies with asset allocations in the risky and risk-free asset of 70:30 and 80:20 respectively. As expected the former sub-strategy shows improved performance from a loss minimizing perspective, although notably the difference is less pronounced than perhaps expected.

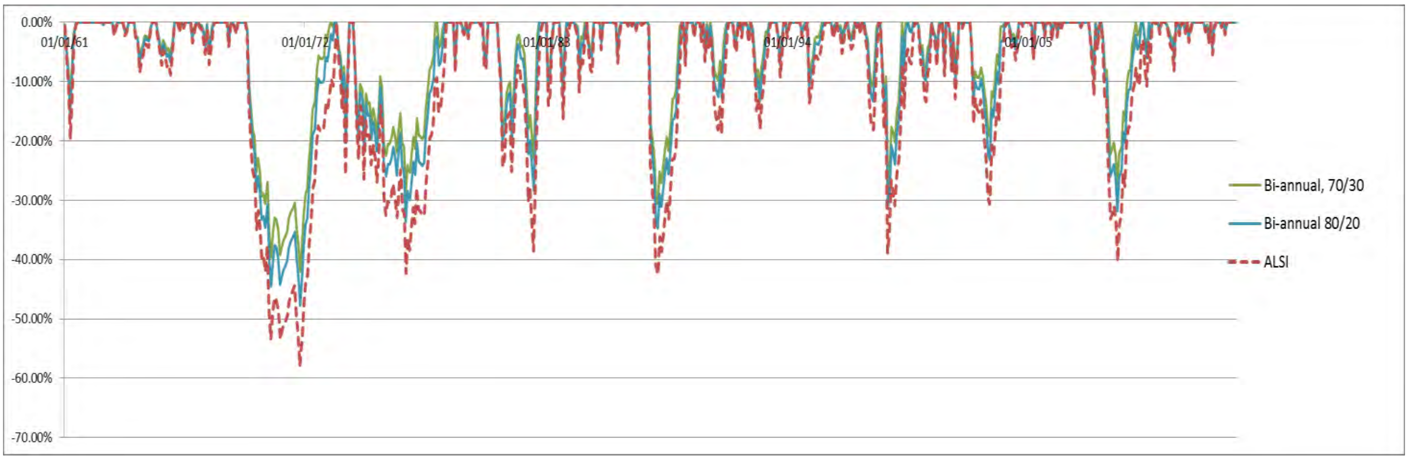

Figure 5.4: Drawdown Analysis of Constant Mix sub-strategies with different asset allocations

The results are shown for a Bi-annual sub-strategy with 70% invested in the risky asset and 30% invested in the risk-free asset, a Bi-annual sub-strategy with 80% invested in the risky asset and 20% invested in the risk-free asset as well a pure ALSI strategy.

5.1.6 CPPI Strategy

Table 5.6: Analysis of individual 12 month CPPI strategies

The CPPI strategy is implemented over 12 months using multipliers to the value of 1.5; 2; 2.5 and 3. Floor values of 60, 70, 80 and 90 are used based on a portfolio value of 100. A portfolio with a multiplier of 2 and a floor value of 70 will originally have 60% invested in the risky asset and rebalance monthly dependant on the performance of the risky asset. Note the floor value increases at the risk-free rate.

Multiplier	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
Floor 60							
m=1.5	15.03%	12.79%	0.507	0.340	0.719	-37.58%	-31.59%
m=2	16.61%	16.97%	0.509	0.447	0.707	-48.96%	-41.05%
m=2.5	17.25%	19.44%	0.500	0.356	0.385	-55.36%	-46.60%
m=3	17.44%	20.13%	0.500	0.305	0.331	-57.39%	-47.88%
Floor 70							
m=1.5	13.68%	9.69%	0.502	0.245	0.620	-27.59%	-23.97%
m=2	15.08%	13.05%	0.503	0.522	1.210	-38.00%	-32.27%
m=2.5	16.22%	16.09%	0.503	0.510	0.845	-46.20%	-39.20%
m=3	16.66%	18.05%	0.492	0.428	0.493	-51.30%	-43.78%
Floor 80							
m=1.5	12.22%	6.55%	0.498	0.107	0.340	-17.46%	-15.50%
m=2	13.27%	8.87%	0.496	0.391	1.013	-24.33%	-21.78%
m=2.5	14.25%	11.25%	0.494	0.673	1.785	-31.76%	-27.72%
m=3	15.04%	13.52%	0.488	0.677	1.543	-38.16%	-33.13%
Floor 90							
m=1.5	10.64%	3.42%	0.493	0.050	-0.394	-6.80%	-6.06%
m=2	11.22%	4.58%	0.489	0.103	0.022	-10.71%	-9.65%
m=2.5	11.81%	5.85%	0.486	0.369	0.893	-14.49%	-13.17%
m=3	12.41%	7.22%	0.481	0.752	2.235	-18.11%	-16.61%
ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

Table 5.6 and 5.7 below illustrate the results of both a 12 month and 24 month CPPI strategy using Floor values between 60 and 90 and Multiplier values between 1.5 and 3. Note that CPPI strategies with longer terms and multipliers were also tested, however, the use of such variables resulted in a serious underperformance of the strategies.

The basic idea of a CPPI strategy is that of portfolio protection. Heuristically, the usage of this strategy is used by an investor who wishes to participate in bullish markets but, as seen in a Stop-Loss strategy, does not wish for the terminal value of the strategy to end up below a guaranteed amount. Unfortunately as our data is calculated on a monthly basis, the results of a basic CPPI strategy are once again subject to Gap risk. This anomaly is evident in the results shown in Table 5.6 and 5.7, where Maximum Annual Loss results are seen to be greater than the Cushion (Portfolio value less the Floor). Note that the occurrence of gap risk is reduced slightly through the monthly floor escalation at the risk free rate.

Table 5.7: Analysis of individual 24 month CPPI strategies

The CPPI strategy is implemented over 24 months using multipliers to the value of 1.5; 2; 2.5 and 3. Floor values of 60, 70, 80 and 90 are used based on a portfolio value of 100. A portfolio with a multiplier of 2 and a floor value of 70 will originally have 60% invested in the risky asset.

Multiplier	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
Floor 60							
m=1.5	15.58%	13.05%	0.538	0.633	1.640	-35.59%	-29.98%
m=2	17.14%	16.89%	0.538	0.571	0.965	-45.90%	-38.40%
m=2.5	17.50%	18.86%	0.521	0.392	0.468	-51.44%	-43.02%
m=3	17.50%	19.58%	0.510	0.307	0.373	-53.73%	-45.11%
Floor 70							
m=1.5	14.20%	10.02%	0.536	0.630	1.843	-25.72%	-22.49%
m=2	15.85%	13.39%	0.546	0.887	2.379	-34.89%	-29.68%
m=2.5	16.89%	15.97%	0.544	0.695	1.266	-42.11%	-35.61%
m=3	17.12%	17.45%	0.526	0.545	0.768	-46.44%	-39.30%
Floor 80							
m=1.5	12.65%	6.88%	0.533	0.521	1.546	-15.94%	-14.32%
m=2	14.03%	9.43%	0.546	1.116	3.984	-21.72%	-19.69%
m=2.5	15.24%	11.79%	0.554	1.226	3.802	-27.95%	-24.52%
m=3	16.12%	13.73%	0.554	1.038	2.495	-33.31%	-28.86%
Floor 90							
m=1.5	10.90%	3.65%	0.529	0.219	-0.090	-6.54%	-5.37%
m=2	11.71%	5.10%	0.531	0.831	2.880	-11.51%	-8.39%
m=2.5	12.62%	6.66%	0.543	1.657	7.386	-13.98%	-11.23%
m=3	13.48%	8.13%	0.556	2.015	8.882	-14.90%	-13.86%
ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

Analysing the results in Table 5.6 and 5.7, it is evident that both risk and returns observed in a CPPI strategy increase with higher multipliers and lower floor values. What is noticeable is that while the Sharpe ratios seen in the 12 month CPPI strategies tend to increase inversely with the Floor values, the 24 month CPPI strategies show higher risk return ratios at higher Floor values. Furthermore, analysis of the 12 month CPPI strategy shows that on average this shorter term trading strategy performs better from a risk return perspective at lower multipliers when tested at numerous Floor levels, yet quite the opposite is observed with the 24 month CPPI strategy, which shows that at higher floor values a larger Multiplier is preferred.

A key finding is the apparent out performance of a 24 month CPPI strategy. Mean Annual Returns are seen to be significantly higher with respect to every variant tested, while some volatility measures, at a floor of 60, are lower than those observed in a one year CPPI strategy. As a result, the two year CPPI strategy yields higher Sharpe ratios than its contemporary along with a superior cash protection performance shown by the lower Maximum Drawdown and Maximum Annual Loss results. These inferences are further promoted by our findings in Figure 5.5 which displays a comparison between the drawdown analyses of CPPI strategies with different duration periods, citrus paribus. On average, CPPI strategies implemented over a 24 month period outperform those implemented over a shorter 12 month period when evaluated over the entire sample period.

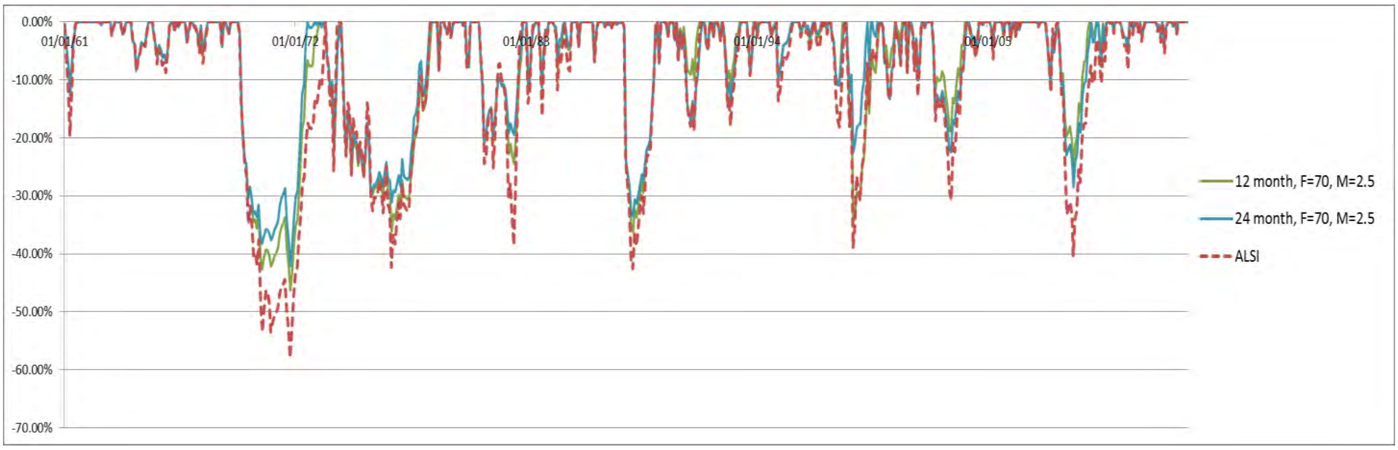

Figure 5.5: Drawdown Analysis of CPPI sub-strategies implemented over different durations

The 'Peak to Trough' results of a 12 month, F=70, M=2.5 CPPI sub-strategy, a 24 month, F=70, M=2.5 CPPI sub-strategy and pure ALSI strategy. A 12 month CPPI strategy is consistently rebalanced on a monthly basis based on the performance of the risky asset, however, after 12 months the portfolio is rebalanced towards the initial asset allocation. In the above strategies, this involves a portfolio with 75% (Multiplier of 2.5 and Floor of 70) invested in the risky asset and 25% invested in the risk-free asset.

The optimal individual sub-strategy is heavily based on the risk tolerance of an investor. It is evident from a risk return standpoint, that the 24 month, Floor=90, Multiplier=3 CPPI sub-strategy[7] yields the best outcome, displaying a Sharpe ratio of 0.556. The modest Mean Annual Return for this strategy of 13.48%, however, leads us to endorse this approach for highly risk averse investors, where the Maximum Annual Loss is only 13.86% (less than half the Maximum Annual Loss observed in a strategy with a Floor of 80 ceteris paribus).

Alternatively, for a more risk seeking investor, a 24 month, Floor=80, Multiplier=3 CPPI sub-strategy yields a slightly lower Sharpe ratio of 0.554 but a Mean Annual Return of 16.12%

[7] A 24 month, Floor=90, Multiplier=3 CPPI strategy refers to a 24 month CPPI strategy with a Floor value of 90 and a Multiplier of 3. This results in a portfolio with an original asset allocation of 30% in the risky asset and 70% in the risk-free asset.

(more than 2.5% higher than the less risky strategy). Note that while this portfolio is constantly being rebalanced, it is rebased every two years into proportions of 60% equity (Multiplier=3 x Cushion = 20) and 40% bonds. Other strategies that have the same base proportions as this optimal sub-strategy, such as the Floor=60, Multiplier=1.5 and the Floor=70, Multiplier = 2, show inferior risk-return payoffs and Maximum Drawdown and Annual Loss figures. It can thus be infered that longer duration CPPI strategies with higher Floor values and higher Multipliers result in improved portfolio performance from a return and cash protection viewpoint. In Addition, for comparative purposes required in Section 5.3, the 24 month, Floor=70, Multiplier=2.5 CPPI sub-strategy has been highlighted as the optimum approach to be used when targeting an initial allocation towards the risky asset of above 60%. This strategy is preferable for more risk seeking investors.

5.1.7 CPPI with Ratchet Modification

The purpose of the ratchet mechanism is to lock in large upside gains made by the risky asset in case of a sudden decrease in portfolio value towards the floor value. Importantly the Ratchet mechanism is only triggered once the portfolio is over invested in the risky asset. At Floor levels of 80 and 90 the Ratchet approach is seldom brought into use and hence the results are markedly similar to those seen using a regular CPPI strategy with an increasing Floor value. Furthermore the outperformance seen using a 24 month CPPI strategy, as opposed to a 12 month strategy, is once again apparent when incorporating the Ratchet approach, thus Table 5.8 and Table 5.9 only incorporate the results for 24 month CPPI strategies at lower Floor values (60 and 70) using a Ratchet modification algorithm.

Table 5.8: Analysis of 24 Month individual CPPI strategies at a Floor of 60 with Ratchet modification

The CPPI strategy with a Ratchet mechanism is implemented over 24 months using multipliers to the value of 1.5; 2; 2.5 and 3. A Floor values of 60 is used based on a portfolio value of 100 along with Ratchet reset values of 0.5; 0.6; 0.7; 0.8. Once the proportion of the portfolio invested in the risky asset increase above the Ratchet reset proportion, the portfolio is rebalanced in line with the adjusted Ratchet formula.

Multiplier	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
Ratchet = 0.5							
m=1.5	14.82%	11.50%	0.531	0.654	1.784	-29.85%	-25.76%
m=2	15.15%	12.50%	0.523	1.022	2.994	-30.42%	-26.79%
m=2.5	15.24%	13.49%	0.502	1.062	2.657	-31.28%	-28.02%
m=3	15.30%	13.86%	0.496	1.080	2.452	-31.34%	-28.30%
Ratchet = 0.6							
m=1.5	15.58%	13.05%	0.538	0.633	1.640	-35.59%	-29.98%
m=2	15.96%	14.13%	0.533	0.852	2.076	-36.15%	-31.00%
m=2.5	16.02%	14.87%	0.518	0.889	1.889	-36.55%	-31.92%
m=3	16.00%	14.95%	0.515	0.916	1.762	-36.11%	-31.80%
Ratchet = 0.7							
m=1.5	15.58%	13.05%	0.538	0.633	1.640	-35.59%	-29.98%
m=2	16.71%	15.76%	0.538	0.683	1.330	-41.53%	-35.04%
m=2.5	16.65%	16.09%	0.528	0.727	1.274	-41.22%	-35.37%
m=3	16.54%	16.01%	0.523	0.762	1.258	-40.23%	-34.76%
Ratchet = 0.8							
m=1.5	15.58%	13.05%	0.538	0.633	1.640	-35.59%	-29.98%
m=2	17.14%	16.89%	0.538	0.571	0.965	-45.90%	-38.40%
m=2.5	17.15%	17.29%	0.531	0.577	0.837	-45.34%	-38.40%
m=3	16.91%	17.02%	0.523	0.620	0.917	-43.96%	-37.56%
ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

As illustrated in Table 5.8 at a low Multiplier of 1.5, the inclusion of a Ratchet mechanism does not result in a change in performance of the strategy as the results are the same as those observed in the original CPPI strategy. The use of higher Multipliers (a greater initial proportion of the portfolio invested in the risky asset) leads to the Ratchet mechanism being triggered and a variation in results.

It is evident that strategies using a higher Ratchet reset are superior compared to those using a lower Ratchet reset from a risk return perspective. Practically this promotes the idea of only Locking in gains made through the risky asset, and triggering the ratchet mechanism, once the portfolio value has increased by a significant amount. Moreover, a Floor value of 70 is optimal when applying the Ratchet mechanism to a CPPI strategy. A 24 month, Floor=70, Multiplier=3, Ratchet = 0.8[8] sub-strategy yields a Mean Annual Return of 17.08% and a Sharpe ratio of 0.534 compared to a strategy with the same variables, albeit a lower Floor value of 60, yielding a Mean Annual Return of 16.91% and a Sharpe ratio of 0.523. The former sub-strategy also shows lower Maximum Annual Drawdown and Maximum Annual Loss results further promoting the use of higher floor values when employing the Ratchet approach.

Table 5.9: Analysis of 24 Month individual CPPI strategies at a Floor of 70 with Ratchet Modification

The CPPI strategy with a Ratchet mechanism is implemented over 24 months using multipliers to the value of 1.5; 2; 2.5 and 3. A Floor values of 70 is used based on a portfolio value of 100 along with Ratchet reset values of 0.5; 0.6; 0.7; 0.8. Once the proportion of the portfolio invested in the risky asset increase above the Ratchet reset proportion, the portfolio is rebalanced in line with the adjusted Ratchet formula.

Multiplier	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
Ratchet = 0.5							
m=1.5	14.20%	10.02%	0.536	0.630	1.843	-25.72%	-22.49%
m=2	15.22%	12.06%	0.542	1.009	2.983	-29.67%	-25.84%
m=2.5	15.39%	12.84%	0.530	1.127	3.019	-30.17%	-26.71%
m=3	15.46%	13.55%	0.515	1.131	2.676	-30.99%	-27.86%
Ratchet = 0.6							
m=1.5	14.20%	10.02%	0.536	0.630	1.843	-25.72%	-22.49%
m=2	15.85%	13.39%	0.546	0.887	2.379	-34.89%	-29.68%
m=2.5	16.20%	14.39%	0.541	0.908	2.025	-35.61%	-30.72%
m=3	16.23%	14.75%	0.534	0.937	1.859	-35.85%	-31.45%
Ratchet = 0.7							
m=1.5	14.20%	10.02%	0.536	0.630	1.843	-25.72%	-22.49%
m=2	15.85%	13.39%	0.546	0.887	2.379	-34.89%	-29.68%
m=2.5	16.81%	15.71%	0.545	0.728	1.351	-40.53%	-34.43%
m=3	16.72%	15.94%	0.535	0.759	1.255	-39.99%	-34.44%
Ratchet = 0.8							
m=1.5	14.20%	10.02%	0.536	0.630	1.843	-25.72%	-22.49%
m=2	15.85%	13.39%	0.546	0.887	2.379	-34.89%	-29.68%
m=2.5	16.89%	15.97%	0.544	0.695	1.266	-42.11%	-35.61%
m=3	17.08%	16.93%	0.534	0.610	0.893	-43.77%	-37.27%
ALSI	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%

[8] A 24 month, Floor=70, Multiplier=3, Ratchet = 0.8 refers to a 24 month CPPI strategy with a Floor value of 70 with a Multiplier of 3 and a Ratchet mechanism coming into effect once the proportion of the portfolio invested in the risky asset exceeds 80%.

Interestingly the optimal individual sub-strategies observed are 24 month, Floor=70, Multiplier=2 at Ratchets resets of 0.6, 0.7 and 0.8. The results are the same as those observed using the regular CPPI approach, however at higher Multiplier and Ratchet resets, the Ratchet approach offers better risk-return performance than the original CPPI strategy. For example a 24 month, Floor=70, Multiplier=3, Ratchet=0.8 sub-strategy shows a Sharpe ratio of 0.534 and a Maximum Annual Loss of -37.27% as opposed to a simple 24 month, Floor=70, Multiplier=3 CPPI sub-strategy which yields a Sharpe ratio of 0.526 and a Maximum Annual Loss of 39.3%.

5.2 Comparative performance of Cash protection strategies

While the optimal sub-strategies using each of the six cash protection strategies tested have been identified, the aim of this paper is to analyse the comparative performance between these various approaches. Using all of the above methods in conjunction, this paper empirically and critically analyses the strategies in order to understand which approaches would be preferable when employing this method of portfolio insurance.

As emphasized previously, the optimal strategy for an investor is heavily dependent on their risk tolerance. It is therefore difficult to state with absolute certainty that one strategy outperforms another although after analysing the results, one can certainly ascertain which strategies would be preferable for investors with specific risk appetites.

The strategy which shows the highest risk adjusted returns is the Lock-In strategy implemented in January at higher threshold levels. Three of its sub-strategies display Sharpe ratios above 0.6 and two of its sub-strategies show higher Mean Annual Returns than a pure risky asset strategy. Possible reasons for the success of such strategies could be attributed to certain behavioural finance anomalies that effect market returns. One such anomaly already identified is the December effect (Cheng and Singal, 2003) whereby stock prices decrease towards the end of the year as investors liquidate their portfolios for tax benefits in anticipation of more costly months ahead. On average the Maximum Drawdown and Maximum Annual Losses seen in the Lock-In strategy are, nevertheless, similar to that of a pure risky asset investment (ignoring those observed in the 24 month January sub-strategies) and as a result the majority of Lock-In strategies implemented cannot be endorsed as acceptable cash protection alternatives for risk averse investors. The results do warrant the attention though of a risk seeking investor with a small appetite for portfolio insurance.

Similarly a 30% July 12 month Fixed Rate Stop-Loss strategy yields a notably high Mean Annual Return. The portfolio, though, would need to lose 30% of its original value in order for the Stop-Loss order to be initiated. This is seen as an extreme outcome although for risk seeking investors who favour a fully diversified equity investment, this strategy is an attractive option. One observes a higher Mean Annual Return when compared to the ALSI

(18.72% as opposed to 18.1%), a lower Standard Deviation of returns (20.26% compared to 20.8%) and a higher Sharpe ratio (0.55 compared to 0.52).

The Rolling Average Stop-loss strategies display comparatively high Mean Annual Returns and Sharpe ratios when compared to the various strategies analysed, most notably when using shorter rolling average durations such as 3 months and 6 months. The use of a 3 month Rolling Average under various threshold levels results in all but one of the sub-strategies outperforming the ALSI from both a pure return and risk-reward perspective.

Interestingly, although the risk related returns across most of the Lock-In and Stop-Loss sub-strategies are very positive when compared to the ALSI and other strategies evaluated, these strategies show consistently high Maximum Drawdown and Annual Loss figures across all thresholds variations, excluding those seen in the 24 month Lock-In strategies implemented in July. This is in complete contrast to those seen in the Constant Mix strategy and the CPPI strategies, with and without the Ratchet modification. These strategies show Drawdown and Annual Loss figures increasing in line with the volatility of the sub-strategies.

The most likely rationale for such an occurrence is that, in both the Fixed Rate and Rolling Average Stop-loss strategy as well as the Lock-In strategy, there is only a once off rebalancing of the portfolio from a risky asset to a risk-free asset after the relevant threshold is reached as opposed to constant rebalancing of the portfolio whilst maintaining some level exposure to both risky and risk-free asset. These large drawdowns seen in supposed low risk strategies are largely responsible for the development of the original CPPI strategy by Black and Jones. The Maximum Drawdown and Annual Loss experienced by the Fixed Rate Stop-Loss sub-strategies occurred in the early 1970's stock crash, right after the end of the late 1960's Bull market on the Johannesburg Stock Exchange. The use of such strategies may therefore be ill advised in times of high market returns based on their failure in the past to protect investors from a sudden loss in portfolio value and hence preferred in times of Bear markets.

The Constant Mix strategy shows the most consistent performance across all sub-strategies in terms of the risk-return spectrum, although the optimum approach fails to outperform the ALSI. Sharpe ratios range from 0.504 and 0.52 compared to 0.25 and 0.64 observed in a Lock-In strategies. Thus the optimal Constant Mix strategy is more highly dependent on an investors risk appetite than the four other strategies tested. This can be explained by a large change in approach taken by an investor leading to virtually the same risk return benefit or, in terms of Modern Portfolio Theory, a move up or down the Capital Allocation Line as opposed to shifting it. From purely a return perspective, the Constant Mix strategy underperforms its contemporaries. The contrarian nature of the strategy whereby the risky asset is sold in upward trending markets reduces the return potential of the strategy although the low volatility and Kurtosis results would suggest this strategy is preferable for risk averse investors who favour consistency, along with commitment, over flexibility.

The CPPI strategy shows the most consistently high Sharpe ratio and Skewness results among the 6 strategies tested, while a 24 month CPPI strategy outperforms a pure risky strategy in terms of reward to variability in all but one of the sub-strategies tested. There is downside in terms of return potential though, as shown in section 5.3, with the returns observed in the optimum CPPI strategies below those seen in the both the optimum Fixed Rate and Rolling Average Stop-Loss strategy as well as the optimum Lock-In strategy.

The results of the CPPI strategy with a ratchet mechanism are similar to those observed using the original CPPI approach. At higher Ratchet reset levels though, the Ratchet approach shows better risk-return performance than the original CPPI strategy as well as lower Maximum Drawdown and Annual Loss figures providing us with some evidence suggesting that the use of Ratchet modification algorithm does provide investors with a better risk-return alternative. These strategies do, nevertheless, offer lower Mean Annual Returns to investors and hence support Van Rensburg et al.'s (2011) conclusion that while the modified ratchet strategy offers greater downside protection than the regular CPPI strategy, its overall performance, with regards to upside potential, falls short of its predecessor. The optimal CPPI strategy is therefore heavily dependent on an investors risk appetite. Risk neutral investors who prefer lower Floor values (below 80) and higher Multipliers (above 2) should include Ratchet reset levels of above 0.5 which is preferable to using a simple CPPI approach. Investors preferring higher Floor Levels and lower multipliers would however have no need to implement a Ratchet strategy in order to improve portfolio performance. The flexibility, however, accompanying both CPPI strategies promotes the use of such approaches in times of both Bull and Bear markets.

5.3 Optimum Cash Protection Sub-strategies

5.3.1 Comparative Performance of Optimum Cash Protection strategies

Table 5.10 shows a comparison of the results for the top sub-strategies under each approach where the initial portfolio allocation towards the risky asset is above 60%. This allows for a Ratchet mechanism to be triggered and hence a difference between the results seen in an original CPPI strategy and a CPPI with a Ratchet approach. The higher proportion of risky assets held in the portfolio from the outset also allows for a more comparable group of results in terms of volatility.

Table 5.10: Comparative performance of Optimum sub-strategies

Results of the six optimum sub-strategies and a straight ALSI strategy are compared. The optimum strategies chosen are the 24 month Lock-In approach at 25% implemented in January, the 12 month Fixed Rate Stop-Loss approach at -5% implemented in July, the 3 month Rolling Average Stop-Loss approach at -5%, the Bi-annually rebalanced Constant Mix approach with an initial portfolio allocation of 70% invested in the risky asset and 30% in the risk-free asset, the original CPPI approach with a Floor of 70 and a Multiplier of 2.5 and a CPPI - Ratchet approach with a Floor of 70, a multiplier of 2.5 and a Ratchet reset of 0.7.

Strategy	Sub-Strategy	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
ALSI	-	18.10%	20.80%	0.52	0.39	0.67	-57.91%	-47.55%
Lock-in	Jan, 24 months, 25%	17.43%	14.89%	0.61	1.01	4.97	-33.74%	-21.82%
FR Stop-Loss	July, 12 months, -5%	17.78%	16.67%	0.58	1.22	2.32	-30.31%	-26.72%
RA Stop-Loss	3 month, -5%	18.71%	17.14%	0.62	0.71	0.91	-48.36%	-29.31%
Constant Mix	Bi-annual, 70/30	15.98%	14.59%	0.52	0.31	0.73	-42.00%	-34.80%
CPPI	F=70, M=2.5	16.89%	15.97%	0.54	0.70	1.27	-42.11%	-35.61%
CPPI-Ratchet	F=70, M=2.5, R=0.7	16.81%	15.71%	0.55	0.73	1.35	-40.53%	-34.43%

The results support, from a South African perspective, Benninga's (1990) findings that the optimum older and simpler strategies tend to outperform the more complicated portfolio insurance strategies in terms of both expected terminal wealth and the reward to risk ratios. The strategy which shows the highest risk adjusted returns is the 3 month -5% Rolling Average Stop-Loss Strategy which displays a Sharpe ratio of 0.62. This strategy involves the reallocation of one's portfolio into a risk-free asset as soon as the 3 month average of returns decreases below -5% and a subsequent reallocation into the risky asset only once this 3 month average is again positive. Furthermore the returns observed using this Rolling Average Stop-Loss strategy far exceed those seen using a fully diversified equity approach (100% in the ALSI at all times). For risk averse investors, however, it may not be the most suitable strategy to implement as the volatility of returns is well above any other strategy tested. The results indicate that, apart from the Rolling Average Stop-Loss strategy, these older, simpler strategies tend to be Leptokurtic (high positive kurtosis) indicating a more peaked normal distribution and greater chance of large negative outcomes. This, however, contradicts the Maximum Drawdown and Annual Loss results observed. Reasons include both sample bias as well the sub-strategies Skewness result. According to Favre (2014), it is possible to have a high excess kurtosis and to have no future extreme negative returns as the extreme returns will only be positive due to the high positive Skewness observed.

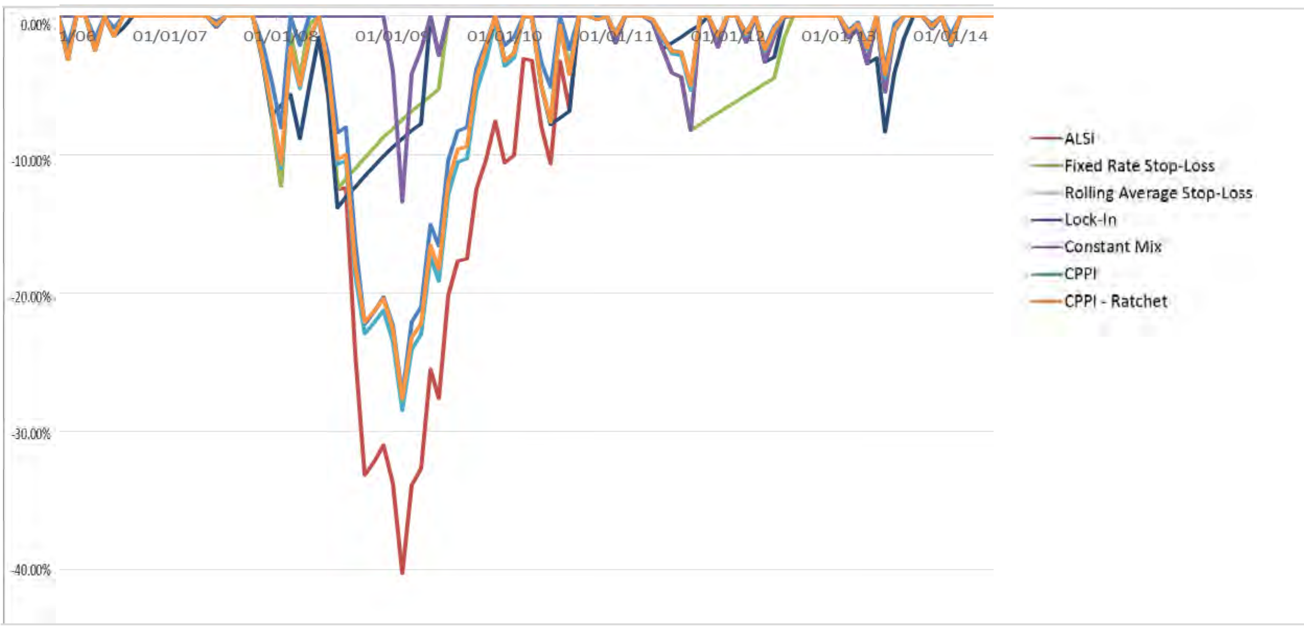

Figure 5.6: Drawdown Analysis of Optimum sub-strategies

The six optimum sub-strategies and the ALSI are analysed using drawdown analysis (peak to trough analysis of returns) during the 2008/2009 Global Financial Crisis.

Figure 5.6 shows a segmented drawdown analysis of the optimum six sub-strategies. The period analysed is during the most recent finanical crisis in 2008/2009. The results further promote the use of the optimum Stop-loss and Lock-In sub-strategies as they show lower peak to trough declines than those seen in the other three sub-strategies. The 12 month 5% July Fixed Rate Stop-loss strategy provides the best from a portfolio insurance standpoint, although the 100% switch to a risk-free asset, after only a 5% drop in original portfolio value, results in a longer time period taken to return back to the highest portfolio value observed. This is due to the lower returns seen in a risk free asset. A portfolio invested purely in the ALSI shows the highest drawdown in this period, while the optimum CPPI trading strategy offers some level of cash protection, albeit slightly less than if an investor incorporated a Ratchet mechansim into one's trading strategy.

5.3.2 Sub-sample analysis of Optimum Cash Protection strategies

We are interested in exploring if performance across the entire sample period of 55 and a half years is accurately reflected across sub-samples. Pursuant to this, the sample period is divided into two equal time periods which roughly reflect a significant change in the government's policy towards exchange controls. The first sub-period tested, which spans a period that roughly captures the impact of Apartheid on the South African economy, is from January 1961 to December 1987 and reflects that of a more isolated economy. The second sub-period tested, which roughly incorporates the post-apartheid era, is from January 1988 to August 2014 and reflects that of a country with more liberalized exchange controls and hence an economy with free movement of capital.

Table 5.11: Comparative performance of Optimum sub-strategies from January 1961 – December 1987

Strategy	Sub-Strategy	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
ALSI	-	18.80%	22.39%	0.617	0.50	0.29	-57.91%	-47.55%
Lock-in	Jan, 24 months, 25%	15.51%	17.06%	0.557	1.45	6.79	-33.74%	-21.82%
FR Stop-Loss	July, 12 months, -5%	20.76%	18.43%	0.797	1.15	1.36	-30.31%	-16.94%
RA Stop-Loss	3 month, -5%	18.04%	18.53%	0.657	0.64	0.18	-48.36%	-29.31%
Constant Mix	Bi-annual, 70/30	16.05%	15.76%	0.657	0.42	0.39	-42.00%	-34.80%
CPPI	F=70, M=2.5	17.40%	17.10%	0.659	0.81	0.86	-42.11%	-35.61%
CPPI-Ratchet	F=70, M=2.5, R=0.7	17.29%	16.76%	0.663	0.85	0.95	-40.53%	-34.43%

Table 5.12: Comparative performance of Optimum sub-strategies from January 1988 – August 2014

Strategy	Sub-Strategy	Mean	Std dev	Sharpe ratio	Skewness	Kurtosis	Max Drawdown	Max Annual Loss
ALSI	-	17.34%	19.10%	0.400	-0.20	-0.23	-42.51%	-37.61%
Lock-in	Jan, 24 months, 25%	19.36%	12.33%	0.699	0.28	-0.48	-18.14%	-11.47%
FR Stop-Loss	July, 12 months, -5%	14.82%	14.70%	0.326	0.42	-0.19	-29.23%	-26.72%
RA Stop-Loss	3 month, -5%	19.32%	15.63%	0.579	0.29	-0.43	-22.26%	-17.83%
Constant Mix	Bi-annual, 70/30	15.79%	15.82%	0.410	-0.27	-0.03	-30.52%	-24.57%
CPPI	F=70, M=2.5	16.32%	14.76%	0.416	-0.03	-0.15	-33.51%	-27.43%
CPPI-Ratchet	F=70, M=2.5, R=0.7	16.81%	14.59%	0.414	-0.03	-0.16	-32.86%	-26.86%

The results indicate a large decrease in the performance of the ALSI, which is assumed to be a proxy for both the risky asset and the South African market as a whole, in post-apartheid times. As illustrated in Table 5.11 and Table 5.12, there is also a significant difference between the performances of all sub-strategies over the two sub-periods tested. The only strategy that shows an improvement in performance from a risk-return perspective in recent times, associated with a more liquid market, , is the optimum Lock-In approach. This strategy has a Sharpe ratio of approximatley 0.7 in the post-apartheid era as opposed to a Sharpe ratio of 0.56 prior to 1988. The remaining strategies show a significant decrease in both return, as well as risk in the latter sub-period, none more so than the optimum Fixed Rate Stop-Loss approach which displays a decrease in Mean Annual Return of 5.94%.

The optimum Rolling Average Stop-Loss strategy shows the most consistent performance across sub-periods in terms of risk and return as highlighted in Figure 5.7 and notably still displays a Sharpe ratio of above 0.57.

The Maximum Drawdown and Annual Loss results show a large decrease in the effects of a worst case scenario on portfolio returns in the post-apartheid era. Notably, the Optimum Lock-In approach, a 25% 24 month July sub-strategy, once again exhibits the lowest Maximum Drawdown and Annual Loss results in this sub-period further promoting its use as an effective cash protection tool.

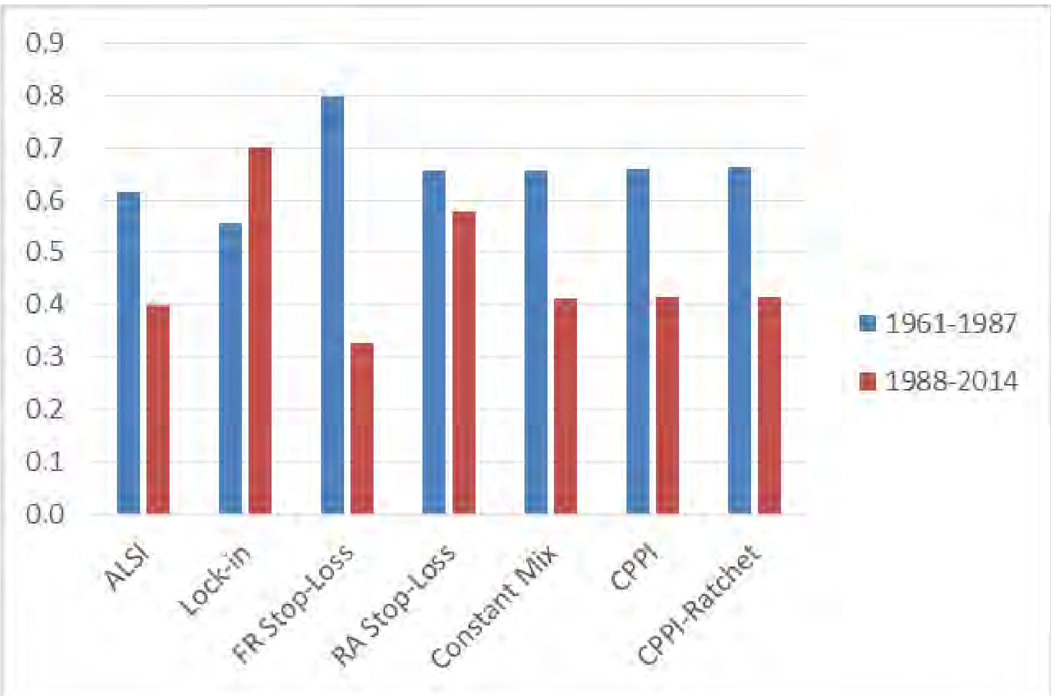

Figure 5.7: Sharpe ratios of Optimum sub-strategies in different sub-periods

Sharpe ratios for the six optimum cash protection strategies and the ALSI are examined over the two different time periods (January 1961 to December 1987 and January 1988 to August 2014).

6. CONCLUSION

With volatility in world markets currently at an all-time high, there is clear focus towards the advancement in the number of portfolio insurance alternatives available to investors globally. The recent economic recovery seen in the United States has led to an expectation of mass capital outflow from emerging markets resulting in an even greater need for capital protection options for investors on the JSE. This study presents a systematic comparison of various dynamic portfolio insurance strategies involving the rebalancing between risky assets (equity) and risk-free assets (bonds). In addition to the popular strategies, such as the Fixed Rate and Rolling Average Stop-Loss, the Lock-In and the Constant Mix strategy, we also apply more recently developed protection strategies, such as CPPI and CPPI with a Ratchet mechanism.

As well as performing a comparative analysis of the 6 strategies, the performance of each individual strategy is evaluated using numerous input variables in order to determine the optimum outcome for each approach. Our comparison of the different portfolio insurance strategies is based on the Sharpe ratio, which combines both the return and risk properties of a given strategy. In addition we use statistical measures such as Skewness and Kurtosis, along with Drawdown and Maximum Loss analysis to determine the inherent cash protection ability of each strategy.

When comparing the results of the six alternative trading strategies, our findings reveal that on average, the CPPI, with and without Ratchet mechanisms, tend to offer more flexibility in terms of downside protection for a given level of risk taken compared to its contemporaries. Including a Ratchet mechanism when the portfolio is heavily invested in a risky asset can further reduce the downside exposure, however, at the expense of upside potential. A Constant Mix strategy offers the least from a risk-return perspective, although it offers the best option in terms of consistency with regards to portfolio volatility. Interestingly, the older, simpler portfolio insurance methods such as the Fixed Rate Stop-Loss, Rolling Average Stop-Loss and Lock-In strategies are the best from a risk-reward perspective provided the ideal trigger levels and implementation dates are used. These strategies, however do not cater well for investors with varying risk appetities and hence lack the flexibility seen in the more recently developed dynamic trading strategies.

From an individual standpoint, there is conclusive evidence supporting the hypothesis that Fixed Rate Stop-Loss strategies implemented in July outperform those implemented at the beginning of the calendar year in January, while the opposite is true for a Lock-In approach which shows notable outperformance in strategies that commenced in January. In Addition, a shorter duration used to calculate the trigger points in a rolling average strategy shows siginifcant outperformane. Our analysis of the Constant Mix strategy promotes the idea of using periodic rebalancing on a semi-annual basis as opposed to constantly adjusting the portfolio towards the predetermined asset allocation. A CPPI strategy is more effective when implemented over a 24 month period, as opposed to both shorter and longer durations, while the use of higher multiplier values offers risk-seeking investors greater return for risk taken on. The inclusion of a a Ratchet mechanism, at high Ratchet reset levels results in an even more effective cash protection option.

While this study has been a measure of relative performance, it provides investors with a clearer perspective when deciding upon an effective cash protection strategy to be used on the Johannesburg Stock Exchange. While past performance may not necessarily guarantee future results, we can conclude that based on our findings over the past 54 and a half years, the use of certain portfolio insurance strategies involving the rebalancing of a portfolio between a risky asset and a risk-free asset does offer investors notably higher risk-return benefits when compared to a pure diversified investment strategy in a risky asset.

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