Adjusting Portfolio Risk/Return Profile with Derivatives

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Introduction

The volatility of the financial markets in the 1970's and early 1980's has led to the development of a host of new financial instruments. Among these new tools for investment management, none have grown faster or been more broadly used than options and futures contracts. However, important questions remain about the role of derivative securities in the world of investment management.

In the aftermath of the stock market crash of October 19, 1987, the Presidential Task Force on Market Mechanism, which produced the Brady Report, maintained that the stock market's decline was accelerated by the trading of index futures contracts by portfolio insurers. Other highly publicized investment losses involving derivative securities, such as the Orange County, California case and the collapse of Barings PLC seem to point out the inherent riskiness of such instruments.

The use of derivative securities without proper knowledge and understanding is undoubtedly very risky. It is essential to understand how the use of options and futures alters risk/return relationships under a specific set of circumstances. When properly implemented, derivatives can be an efficient method of controlling for a portfolio's risk.

Although there are a host of derivatives on various financial instruments, the focus of this paper will be specifically on derivatives of equity securities, equities options, stock index options, and stock index futures contracts.

Characteristics of Equity Options

An equity option gives the holder of the option the right to either buy (call option) or sell (put option) the stock at a pre-determined price. An option is a derivative instrument in that, the price of the option contract must be "derived" from an underlying asset, such as a common stock. The characteristics of these instruments are such that, it will allow the users of these products to alter the risk return characteristic of an asset.

Prior to the advent of the equity options market, portfolio risk/return characteristics focused on the theory of efficient frontier. The risk/return relationships under this method were adjusted by allocating assets among varying asset classes with different correlation. Portfolio risk management can now be more efficiently achieved by implementing hedging strategies with options and other derivative instruments. There are now various ways in which a portfolio can move along the risk/return curve without having to reallocate assets into varying low correlation asset classes. For instance, options are an efficient instrument for transferring risk. This risk transference capability of options can assist a portfolio manager in achieving some specific portfolio results.

Option prices are governed by strict mathematical principles. The value of an option before expiration depends on five factors; the price of the underlying stock, the exercise price of the option, the time remaining until expiration, the risk-free rate of interest, and the possible price movements of the underlying stock. In an efficient market, an arbitrage opportunity can result if the instrument price deviates from the option pricing principle. These factors set general boundary conditions for possible option prices.

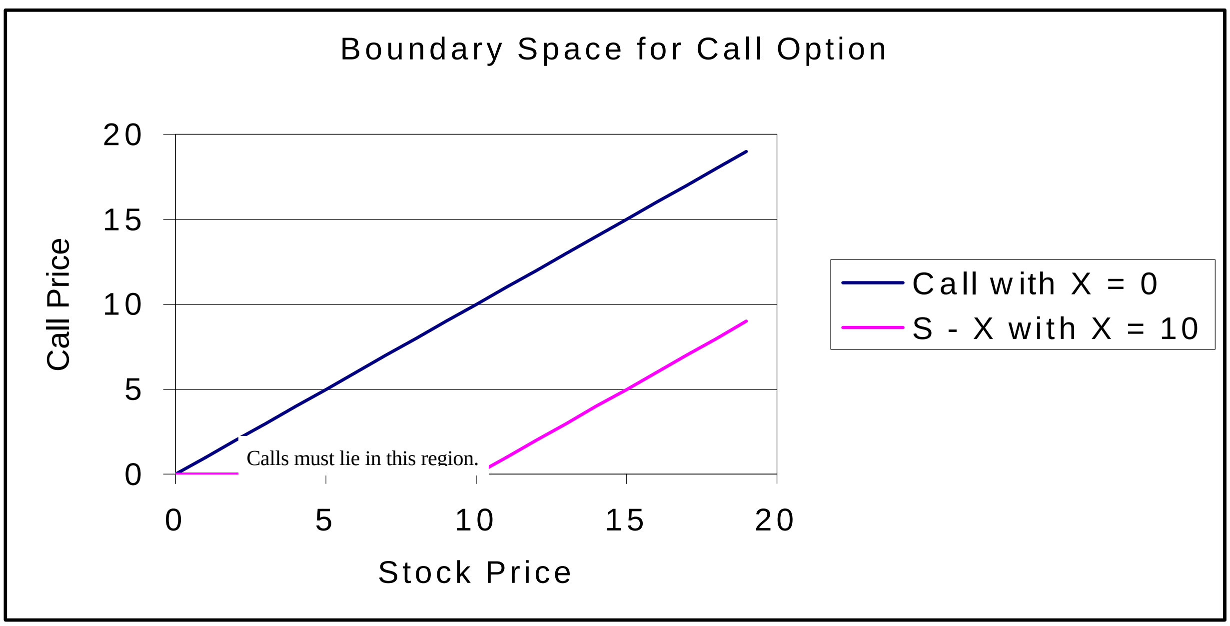
Boundary Conditions

The value of an option at expiration must be: $C_T = MAX\{0, S_T - X\}$ and $P_T = MAX\{0, X - S_T\}$

where: C_t = the call price at time *t*
P_t = the put price at time *t*
S_t = the call price at time *t*
X = the call price at time *t*
T = the call price at time *t*

However, before expiration option prices do not have to conform to the above equations. Our task is to determine the range of possible option prices before expiration. The ranges of possible option prices are the boundary space conditions for an option. To define the boundary space for an option, we focus on the extreme values for the variables that affect the option prices.

The price of an option must satisfy the following conditions. An option that is otherwise the same, the one with the lower exercise price must be greater than the option with the higher exercise price. Next, an option that is otherwise the same, the one with the longer time until expiration must have a price at least as great as the option with the shorter maturity. Therefore,



the value of an option will be highest for an option with a zero exercise price and an infinite time until expiration.

At expiration, for any stock price above the exercise price, the upper bound for any call option must be the stock price. If the stock price is at or below the exercise price the call is worth zero.

For a put option, the most that a put holder can receive is the price of the exercise price, therefore the lower the stock price, the more valuable the put option. There is one distinction that must be made between an American and European option. The American option holder can exercise at any time, while the European option holder can only exercise at expiration. The value of an American put must be at least equal to the exercise price if the stock is worthless. For a European put option before expiration, the maximum possible value equals the present value of the exercise price since the owner of the European put must wait until expiration to exercise.

PRINCIPLES OF OPTIONS VALUATION

Using the principle of the no-arbitrage condition, the following relationships between call and put option prices must exist.

- The lower (higher for put options) the exercise price, the more valuable the call option. The only exception to this principle would occur when the options are far out-of-the-money and there is virtually no chance that the lower price option can finish in the money. In this case both options would have a very low price and would be nearly worthless.

- The difference in the Call prices cannot exceed the difference in Exercise price.

- The Put-Call parity relationship states that a put option is worth the same as a portfolio of long call, short stock, and a risk-free investment that pays the exercise price on the common expiration date of the call and put option.

OPTION STRATEGIES:

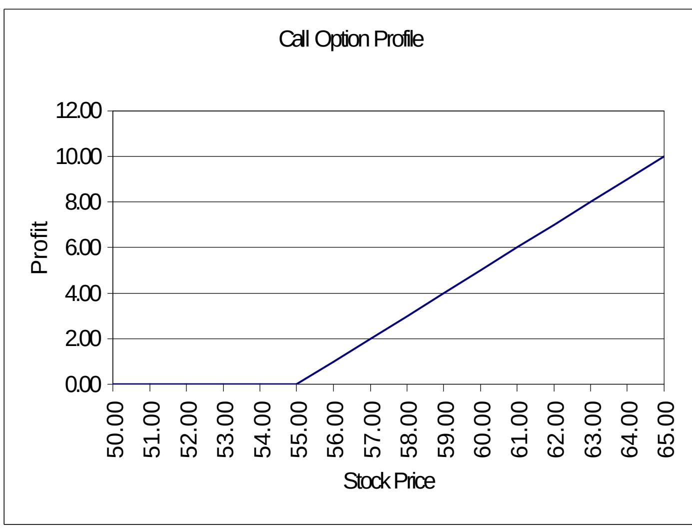
There are three very broad option strategies:

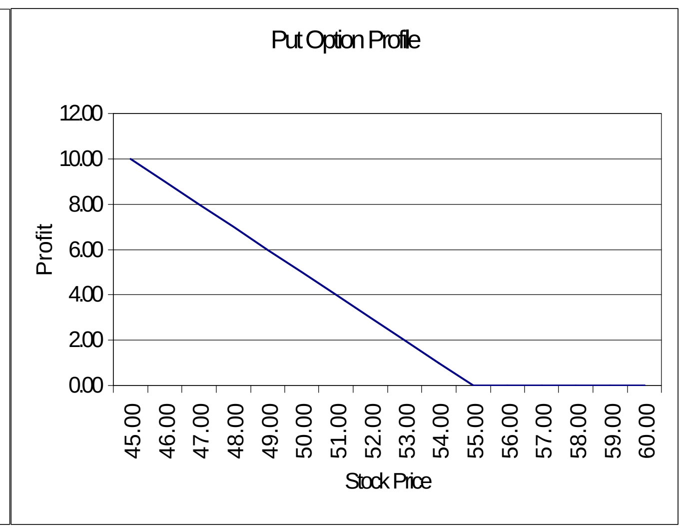
- Purchase - expecting to profit from the movement in the value of the underlying asset.
- Sale of options - to profit from the receipt of option premium.
- Combination of purchase and sales to create a spread position that provides limited upside gains and losses.

Option Buying

Call buying is the simplest form of option investment. The purchaser of a call option will profit when the underlying asset increases in price. The success of a call buying strategy depends on the ability to time the selection of a stock that will go up. The main attraction to this strategy is that the purchaser has a great deal of leverage and potential for large profits with a loss limited to the purchase price.

The most important fact for a call buyer to realize is that the only way to profit from this position is if the stock price increases. Furthermore, for an outright purchase to be profitable the purchaser must not only select the right underlying stock, but also must time the purchase where the price increase occurs during the time of the option period.

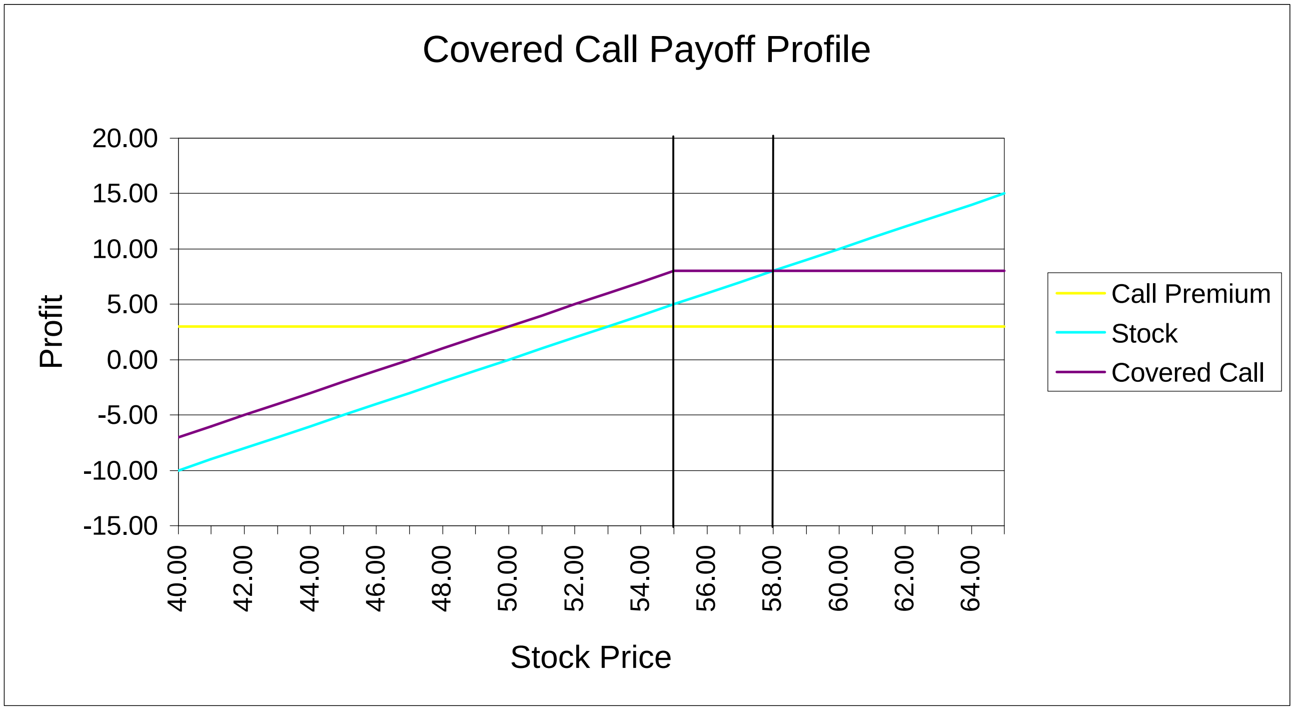




In the chart above, a stock is currently trading at $50 and a 6-month option with a strike price of $55 is selling at $3. The call option payoff profile shows that at any stock price of $55 or less at expiration, the option will be worthless. However, should the stock price increase by $10, or 20%, the option will be worth $5 at expiration, and the call buyer will have a profit of over 67% on a move in the stock of 20%. The put option position has a payoff profile that is a mirror image of the call option. For a put option, the maximum loss will be realized at stock prices above $55. The difference between the call and the put option is that, the profit from the put option is limited to the stock price at 0, or the exercise price of the put, whereas the theoretical profit from a call option is unlimited. Both a call and a put magnify the gains or losses through leverage, and it is this leverage from options that attract speculative buyers into the market.

Covered Calls

This strategy refers to the selling of a call option while simultaneously holding the same number of shares in the underlying stock. This is another bullish position that can be established with options. However, unlike call buying, the covered call write is a more conservative position that can reduce the risk of owning stock. Although a covered call write can reduce the risk of stock ownership, it does not eliminate the risk. There are two types of risk to consider in a covered call position. First, the stock price can fall by an amount greater than the premium received from the call option premium. Second risk is the opportunity cost of the position. By writing or selling a call option against the stock, the seller will always limit the profit potential from the stock and therefore will not participate fully in a strong upward move in the underlying stock.



The covered call option profile above is illustrated using the same example of a stock trading at $50 with $55 strike, and 6 months until expiration trading at $3. The covered call position has a maximum profit of $8, and this occurs at stock prices above $55. However, at stock prices higher than $58, the return from the covered call position is less than stock only position. At stock prices less than $55, we can see that the covered call position returns $3 more than the stock only position.

The primary objective of covered call writing is to increase income from stock ownership. The covered call strategy works best when stock prices remain the same or rise slightly. During periods of declining stock prices, the covered call strategy will outperform stock only position, but does not limit the downside risk. The only time that outright stock ownership will outperform the covered call position is when stock prices increase by a relatively substantial amount.

Option Spreads

Spread positions are established when one option is purchased while another option with different terms on the same underlying stock is simultaneously sold. The basic idea behind the spread position is to reduce the risks of buying an option by selling another. There are three broad categories of spread positions, vertical, horizontal, and diagonal. A vertical spread position involves two options that have the same expiration but different strike prices. Horizontal spread is a position with the same strike price but different expiration dates. The diagonal spread is a combination of a vertical and horizontal spread that have different expiration dates and strike prices. Investors that are taking spread positions are trying to make small profits while limiting the risks.

The bull spread with call options and bear spreads with put options are one of the more frequently used forms of option spread trading. In a bull spread, an option with the lower strike price is purchased, and at the same time an option with a higher strike price is sold. The opening position will establish a debit transaction, however a smaller investment is required than does an outright call purchase. In a bull spread, the position is profitable if the underlying stock price move up, and the maximum profit is realized when the stock price equals the higher strike price.

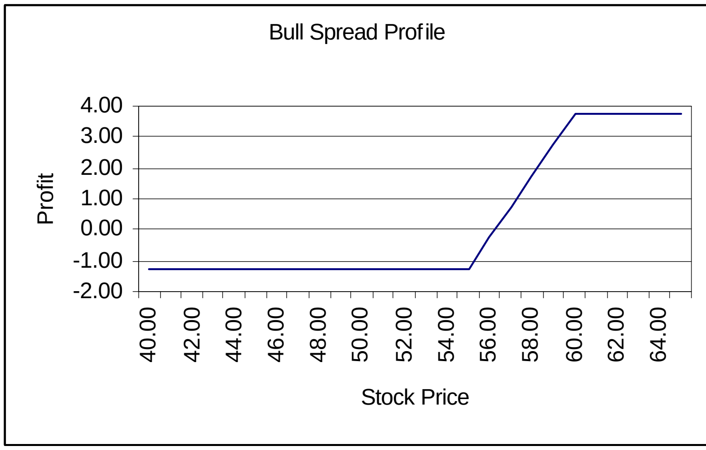
For example, assume that the following conditions exist in the market:

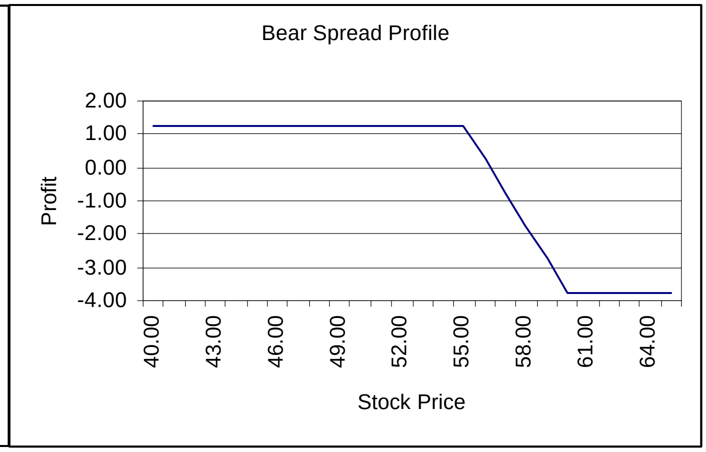
Stock price = $50
6 month Call 55 Strike = $3.00
6 month Call 60 Strike = $1.75

A bull spread would be established by buying the $55 calls and selling the $60 calls for a net debit of $1.25. The maximum loss will be realized at stock prices less than the lower strike price of $55 at expiration, and that is equal to the net debit to establish the position. The breakeven will lie between the two strike prices, and the maximum profit will be realized at stock prices above the higher strike price.

Break-even = Lower Strike + Net Debit or $55 + $1.25 = $56.25
Maximum Profit = Higher Strike - Lower Strike - Net Debit or $60 - $55 - $1.25 = $3.75

An investor that establishes a bull spread position can be considered bullish on the underlying stock, but may be looking for a way to hedge or reduce the downside risk. In general, if an investor is expecting a sustained rise in the stock, an outright call purchase would be a better strategy. However, a bull spread position will outperform the outright purchase of a call if the stock advances slowly until expiration.





Like the bull spread, the bear spread is a vertical spread position with limited profit and loss potential. However, in a bear spread, the lower strike option is sold and a higher strike option is purchased, creating an initial net credit position. Using the same example as the call spread, the maximum profit in the bear spread is $1.25 or the net credit received. The maximum loss would be $3.75, and this loss would be realized at stock prices above $60. These types of spread positions may also be undertaken with put options and other combination of instruments, creating a similar payoff profile with limited upside potential and downside loss.

Futures Contracts

The major distinction between an option and a futures contract is that the futures contract is an obligation and not a right. For this reason, the theoretical option price is not computed entirely on a cost to carry basis the way that a futures contract price is computed. Both the futures and options price will depend on the time remaining to expiration, the price of the underlying instrument, dividends, and the risk free rate. The crucial difference in calculation of theoretical value is that the option price depends on the volatility of the underlying asset. With options you're buying and selling volatility. Futures simply involve delayed payments.[1] Since a futures contract is a legal commitment to buy or sell a security, the instrument provides for holder to either take delivery or make delivery at some date in the future, much like a forward contract.

The price of a stock index futures contract is equal to the price of a stock, or stock index, plus the risk-free rate of return that can be earned, less the dividend received. The futures price is then equal to the spot cash price plus the cost of carry. We can price a futures contract by calculating the return to the hedged portfolio (RHP). Suppose we buy a stock today at S, we agree to sell it in the future at F, and we are entitled to a dividend of D. The cash flow today is -S, +F in the future, and +D dividend received. The return to the hedged portfolio RHP = F - S + D. Since the sum of the RHP is known with certainty, that return should be equal to the risk free rate of return. If the RHP is greater than the risk free rate, then the futures contract is overpriced, and we would earn a rate of return higher than the risk free rate without any more risk.

Futures Strategies

Financial futures can be used to hedge a portfolio of assets. This use may be to minimize fluctuations of market value, to assume a defensive market posture to earn a risk free rate of return, or to engage in speculation. The futures markets are large and extremely liquid offering managers of investment portfolios an easy way to alter the portfolio exposure with very little transactions costs.

USES OF STOCK INDEX FUTURES:

- Portfolio Hedging
- Market Timing Strategies
- Portfolio Insurance
- Portfolio Allocation

One of the most popular strategies with stock index futures is the hedging of a portfolio to control the exposure to market risks. Until the creation of stock index futures, the only available method for removing systematic market risk was through a program of portfolio asset allocation. The stock index futures contracts allow investors to eliminate market risk with a minimal amount of transaction costs. As with all futures contracts, both long and short hedges may be established with stock index futures contracts. When creating a hedge with stock index futures, such as the S&P 500 Index futures contract, the characteristics of the portfolio must be taken into account. The amount of the hedge and the number of contracts to hedge with can be calculated using a hedge ratio. The hedge ratio can be used to control the amount of market risk, it can either minimize or increase the systematic risk.

The basic hedge ratio can be determined by the formula:

$(V_P/V_F) \times \beta_p$ = number of contracts
where,
V_P = value of the portfolio
V_F = value of the futures contract
β_p = beta of the portfolio

As a practical matter, for hedging purposes, the βeta of the portfolio can be calculated from regressing the portfolio returns on the returns of the futures contract, and may not be the same as the CAPM beta[2].

In an equity portfolio that is well diversified, the only risk that exists will be the systematic market risk. Using the hedge ratio, the systematic risk of the portfolio can be adjusted to any level by the investor. In a risk minimizing hedge, a combination of short stock index futures and long stock portfolio can reduce the systematic risk to zero, leaving only the risk free rate of return for the portfolio. It is also possible to use the stock index futures to increase the level of systematic risk in a stock portfolio.

Portfolio Management Application

As mentioned earlier, derivative securities have many uses ranging from speculation to arbitrage, but the most widely used application of derivatives are in portfolio management. By combining options and futures with equity portfolio holdings, the portfolio's risk/return profile may be adjusted to a predetermined level.

In our example, we will examine the portfolio payoff profile by combining various options and futures position to our portfolio. The portfolio will consist of holdings in domestic large cap value and growth stocks, and small cap stocks. The composition of this portfolio should be similar to the domestic equities holdings of most institutional portfolios.

SAMPLE PORTFOLIO COMPOSITION:

The futures and options are instruments will be based on S&P 500 and Russell 2000 indexes. The option prices used here are not historical prices, but calculated theoretical values using the Black-Scholes option pricing model with actual historical inputs. The volatility used in calculating the option prices are based on observed 45 days of trading.

Portfolio Insurance

Portfolio insurance strategy is primarily designed to limit the loss of principal of the portfolio while providing an opportunity to participate in upside appreciation. The cost of establishing such a position is analogous to the payment of an insurance premium. The appreciation potential of the portfolio will always be less than the uninsured portfolio by the cost of the insurance. Using our sample portfolio, we will establish an insured portfolio using put options on the S&P 500 and the Russell 2000 indexes.

In order to insure the portfolio, the amount of the insurance should be adjusted to the portfolio beta, and the delta of the put option. The portfolio insurance strategy would be appropriate for fund managers that have a minimum balance that they would like to protect, but wish to capture the upside in an equity portfolio.

For example, suppose we have a $100 million portfolio that is invested in the following equity funds:

Initial Portfolio Value	$ 100,000,000				
	Vanguard Index 500	Vanguard Growth Index	Vanguard Value Index	Vanguard Extended Mkt	Vanguard Small Cap Index
Allocation:	20%	20%	20%	20%	20%
Beta Coefficient	0.993	0.998	1.014	0.912	0.964

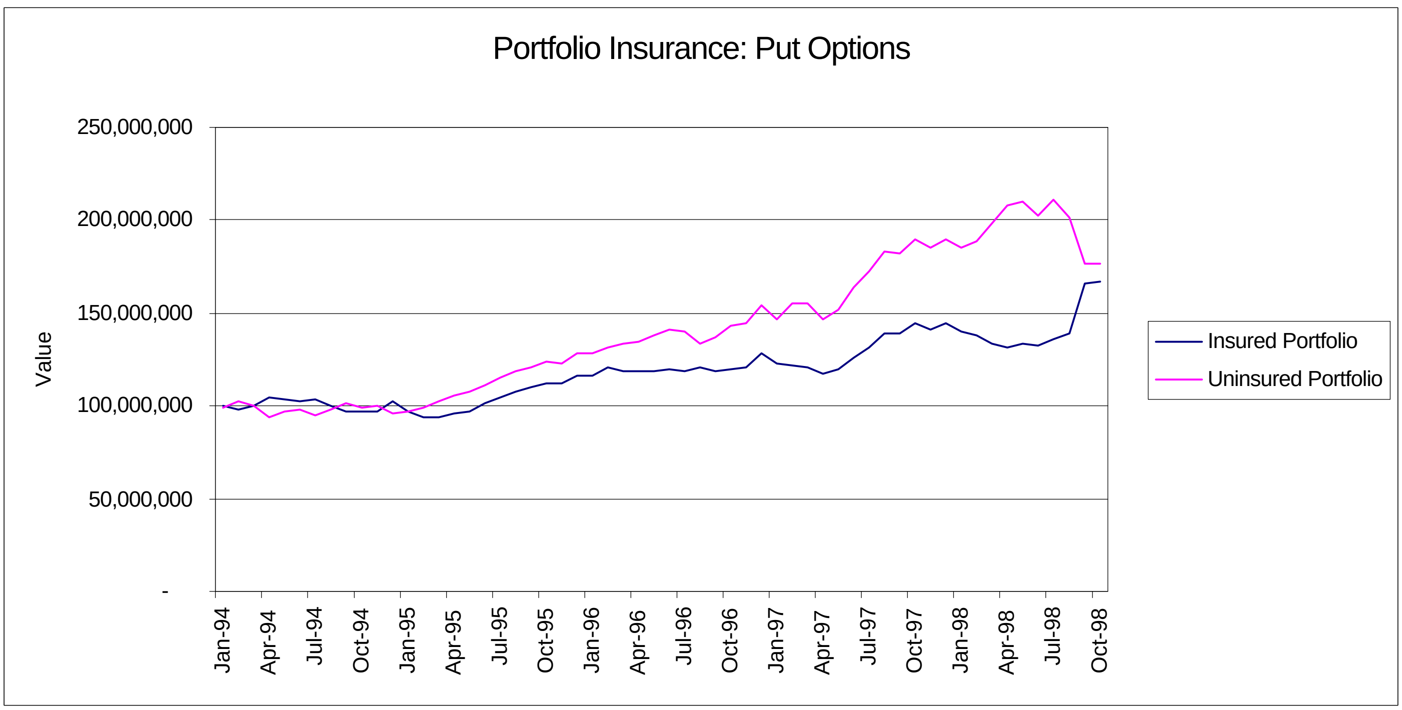
The weighted average of the beta coefficient for the Large Cap segment of the Vanguard funds and the S&P 500 Index was 1.00, and the weighted average of the beta for the Vanguard Extended Market and Small Cap Index with the Russell 2000 was .94. The number of option contracts to purchase was calculated by assuming that the portfolio insurance was put in place on the first trading day of each year using a put option with one year maturity.

S&P 500 Put Option contracts: 1 year maturity

465 Put Jan. 1994 ($60,000,000 ÷ (465.44 × 100)) × -β) = -1,291 ÷ Put Δ (-0.4358) = 2,963

460 Put Jan. 1995 ($58,072,437 ÷ (459.11 × 100)) × -β) = -1,267 ÷ Put Δ (-0.3678) = 3,446
620 Put Jan. 1996 ($69,994,366 ÷ (620.74 × 100)) × -β) = -1,130 ÷ Put Δ (-0.3518) = 3,211
735 Put Jan. 1997 ($73,637,164 ÷ (736.99 × 100)) × -β) = -1,001 ÷ Put Δ (-0.3582) = 2,795
975 Put Jan. 1998 ($84,188,392 ÷ (975.00 × 100)) × -β) = - 865 ÷ Put Δ (-0.3881) = 2,229

Russell 2000 Put Option contracts: 1 year maturity
255 Put Jan. 1994 ($40,000,000 ÷ (256.53 × 100)) × -β) = -2,343 ÷ Put Δ (-0.3674) = 6,378
245 Put Jan. 1995 ($38,714,958 ÷ (247.24 × 100)) × -β) = -2,353 ÷ Put Δ (-0.3223) = 7,301
315 Put Jan. 1996 ($46,662,910 ÷ (316.81 × 100)) × -β) = -2,213 ÷ Put Δ (-0.3317) = 6,672
360 Put Jan. 1997 ($49,091,443 ÷ (358.96 × 100)) × -β) = -2,055 ÷ Put Δ (-0.3365) = 6,107
435 Put Jan. 1998 ($56,125,595 ÷ (436.52 × 100)) × -β) = -1,932 ÷ Put Δ (-0.3597) = 5,372



The attraction of the put insurance strategy is the ability to participate in a rise in equities while providing protection against loss of principal. The difference in the value of the insured and uninsured portfolio is the cost of the insurance, or the amount of the put options premium. In our example, the insurance amount was rolled forward at the beginning of each year.

Through the beginning of Jan. 1998 the insured portfolio strategy was able to capture about 55% of the increase in an uninsured portfolio, while ensuring that the portfolio value would not drop below the level from the beginning of the year. We used the simplest method of portfolio insurance, by assuming a purchase of an exchange traded put option. However in actual practice, there may not be an exchange traded option that meet our requirements. In that case, we would have to create an insured portfolio using other methods, such as dynamic hedging and call-treasury bill insurance. Regardless of which method is used to insure the portfolio, we should recognize the fact that the cost of insurance consists of not only transactions costs, but the opportunity costs of foregone returns.

Beta Control

The ability to modify systematic market risk of a portfolio is another application that can be easily implemented using stock index futures contracts. Using a combination of equity holdings and futures contracts, we can adjust the level of systematic risk in our portfolio based on our preference. We can simply use the variance hedge ratio to calculate the number of futures contracts to buy or sell to create our desired portfolio beta.

The variance hedge ratio is found by: $N = (\beta_T - \beta_S) \times (S \div f)$

where, N = number of contracts

β_T = portfolio's target beta

β_S = portfolio's beta

S = equity portfolio value

f = price of futures contract

We can see from this formula that if the target beta is higher than the portfolio's beta, we would add systematic risk by buying futures, or we would sell futures if the target beta is less than the portfolio's beta. Using our existing portfolio, assume that we have a positive outlook for the stock market. We could increase our existing portfolio's beta by using the S&P 500 and Russell 2000 futures contract.

For our example, we want to increase the level of systematic risk to 1.25 using the nearest expiration month futures contract. The initial portfolio position is:

Vanguard Index 500	Vanguard Growth Index	Vanguard Value Index	Vanguard Extended Mkt	Vanguard Small Cap Index	Unhedged Total Portfolio Value
$ 20,000,000	$ 20,000,000	$ 20,000,000	$ 20,000,000	$ 20,000,000	$ 100,000,000

Portfolio Statistics:

FUND BETA:

Description	Vanguard Index 500	Vanguard Growth Index	Vanguard Value Index	Vanguard Extended Mkt	Vanguard Small Cap Index
S&P500 Index	0.983	0.999	1.015	1.122	1.072
S&P500 Futures	0.971	0.984	0.994	1.107	1.063
Russell2000 Index	0.560	0.510	0.610	0.854	0.901
Russell2000 Futures	0.584	0.537	0.645	0.911	0.960

Portfolio's beta: S&P 500 $(.333 \times .971) + (.333 \times .984) + (.333 \times .994) = 0.98$

Russell 2000 $(.5 \times .854) + (.5 \times .901) = 0.88$

Futures contracts: S&P 500 $[\$60,000,000 \div (464 \times 500)] \times (1.25 - .98) = 69$ Contracts

Russell 2000 $[\$40,000,000 \div (252.5 \times 500)] \times (1.25 - .88) = 118$ Contracts

DATE	Value of S&P Benchmark Portfolio	Change in Value of Portfolio	Equity Portfolio Return	S&P 500 Contracts	Value of S&P Futures	Total Portfolio Return
Dec-93	$ 60,000,000	$ -		69	$ 16,023,865	
Oct-98	$ 126,140,882	$ 66,140,882	74.31%	69	$ 34,030,455	87.65%
DATE	Value of Russell Benchmark Portfolio	Change in Value of Portfolio	Equity Portfolio Return	Russell 2000 Contracts	Value of Russell 2000Futures	Total Portfolio Return
Dec-93	$ 40,000,000	$ -		118	$ 14,897,500	
Oct-98	$ 50,119,816	$ 10,119,816	22.55%	107	$ 18,727,140	29.92%

This example was constructed using the nearest expiring month futures contract. For simplicity of calculations, the contracts were assumed to have been rolled forward and the hedged amount was adjusted on the first trading day of each month. The equity portfolio holding period returns from Dec. 1993 until the beginning of Oct. 1998 are calculated as follows:

Portfolio Return ($ 66,140,882 + $ 10,119,816) ÷($ 60,000,000 + $ 40,000,000) = 76.26%

Adjusted Retun ($66,140,882 + $10,119,816 + $18,006,590 + $3,829,640) ÷ ($100,000,000) = 98.10%

The additional risk to the portfolio by holding the futures, increased the "Beta Adjusted" portfolio return by almost 30% (98.10% ÷ 76.26%) versus the equity only portfolio. Of course in a declining market, we would expect to see the higher risk portfolio return about that much less.

It is the flexibility offered by the use of futures contracts that make it attractive as a tool for portfolio management. If we were concerned about a potential decline in the equities market, we could easily use the futures contract to reduce to zero, with relatively very little transactions costs, the amount of systematic market risk. In this case, we would expect our portfolio to return the risk free rate, which by definition is a zero Beta, or riskless asset. Any amount we earned more or less than the risk free rate, can be attributed to the Alpha (α) of the portfolio. Applying the CAPM theory, a zero Beta portfolio with a positive α would denote the securities selection skills of a portfolio manager.

Multiple Manager Control

Stock index futures can also be used effectively to control asset allocation decisions. Institutional investors in particular can use strategic applications of index futures to control exposure to various sub-classes or equity styles. For example, a typical pension plan sponsor that employs multiple manager strategies can not only reallocate assets efficiently, they have the ability to control the style exposure of their multiple manager program. Assume that a plan sponsor detects a temporary shift of a manager's equity style exposure. The plan sponsor has two options available. First, they can shift their equity exposure by actual sales or withdrawal of funds, or they can buy or sell futures contracts and control their equity style exposure. Going back to our hypothetical portfolio, assume that the equity portfolio is allocated as follows: 60% benchmarked against the S&P 500 and 40% with the Russell 2000 Index.

Description	Vanguard Index 500	Vanguard Growth Index	Vanguard Value Index	Vanguard Extended Mkt	Vanguard Small Cap Index	Total Value of Portfolio
Allocation	20%	20%	20%	20%	20%	100%
Value	20,000,000	20,000,000	20,000,000	20,000,000	20,000,000	100,000,000
Price 12/30/93	43.78	10.18	11.77	19.41	16.31	
Shares Owned	456,829.60	1,964,636.54	1,699,235.34	1,030,396.70	1,226,241.57	

Portfolio Return			
199401 through 199810			
STYLE:			
	Proportion		
S&P500	0.761		
Russell	0.239		
ANNUALIZED VALUES:			
	Fund	Style	Selection
Mean	11.727	13.556	-1.829
Std. Dev.	12.761	12.174	2.599
STATISTICS:			
	Value		
Pct Active	4.15		
Sel. Sharpe Ratio	-0.70		
T-statistic	-1.55		
Percentile	6.09		

Using the style analysis technique that Prof. William Sharpe developed, we can see that the portfolio has more than 75% exposure to the S&P500 and less than 25% to Russell 2000 index.[3]

Assuming that the investor desired an equity benchmark exposure of 60% to S&P 500 and 40% to the Russell 2000 Index, the portfolio exposure can be easily adjusted using the stock index futures contracts. In this case, we could short the S&P 500 and buy the Russell 2000 futures contracts to come up with the desired exposure level. Sharpe's style analysis of our portfolio tells us that we currently have a 76% exposure to the S&P 500 and 24% to the Russell 2000 Index. We can adjust our portfolio exposure by increasing our fund allocation to either the Vanguard Extended Market or Small Cap fund, or we can short $16 million (16% of portfolio) of S&P 500 futures and purchase $16 million of the Russell 2000 Index futures contracts. One of the advantages of using the futures contracts is that we can adjust our portfolio efficiently with a relatively low transaction costs.

The initial futures contracts position to adjust the portfolio exposure to 60% S&P 500 and 40% Russell 2000 are as follows:

($16,000,000 ÷ (464 × 500)) × -1 = -69 S&P 500 Contracts

($16,000,000 ÷ (253.50 × 500)) = 126 Russell 2000 Contracts

Hedged Portfolio Return			
199401 through 199810			
STYLE:			
	Proportion		
S&P500	0.604		
Russell	0.396		
ANNUALIZED	VALUES:		
	Fund	Style	Selection
Mean	11.108	12.150	-1.042
Std. Dev.	13.163	12.623	2.228
STATISTICS:			
	Value		
Pct Active	2.86		
Sel. Sharpe Ratio	-0.47		
T-statistic	-1.03		
Percentile	15.19		

The style analysis results were tested for the adjusted portfolio with one year futures contracts rolled forward on the first trading day of each year. The results of the style analysis shows that futures contracts can be an efficient means of controlling a portfolio of multiple fund managers. The portfolio returns attributes now indicate that the portfolio behaves as if the funds are allocated 60% to match the S&P 500 and 40% to the Russell 2000 Index. In practice the results may not be as close as our example because most funds do not correlate with their benchmarks as well as the Vanguard funds. However, by using Sharpe's portfolio style analysis in conjunction with futures and options positions, investors have an efficient means of controlling the trading exposure of their multiple external fund managers.

Conclusion

There are many applications for derivative instruments in portfolio management, but the usefulness of these products are in that investors have a tool that they can use to effectively manage their portfolio's risk exposure. The goal of portfolio management is to produce a maximum rate of return for a predetermined level of risk exposure. Options and futures are useful tools that can facilitate this strategic portfolio management process in an effective manner. We are all well aware of some recent highly publicized failures attributed to the use of derivative securities. Since derivative instruments can either add to or reduce the level of risk in our portfolio, to properly implement portfolio management strategies with derivatives, we need to develop an understanding of how a particular position will affect the normal risk/return profile of the underlying portfolio of assets.

Appendix

DATE	Vanguard Index 500	Vanguard Growth Index	Vanguard Value Index	Vanguard Extended	Vanguard Small Cap
Dec-93	40.94	10.18	11.77	19.41	16.31
Jan-94	41.34	10.18	11.71	19.31	15.58
Feb-94	42.66	10.38	12.23	19.97	16.22
Mar-94	41.42	10.17	11.77	19.63	16.11
Apr-94	39.23	9.55	11.01	18.40	15.11
May-94	40.55	9.82	11.43	18.97	15.58
Jun-94	41.10	9.92	11.64	18.84	15.39
Jul-94	40.17	9.69	11.26	18.27	14.91
Aug-94	41.55	9.98	11.70	18.77	15.17
Sep-94	42.80	10.43	11.86	19.50	15.88
Oct-94	41.87	10.27	11.40	19.34	15.83
Nov-94	42.53	10.48	11.53	19.39	15.73
Dec-94	40.88	10.07	11.07	18.55	15.08
Jan-95	41.90	10.25	11.15	18.40	14.86
Feb-95	42.99	10.53	11.43	18.79	14.88
Mar-95	44.53	10.94	11.79	19.43	15.39
Apr-95	46.09	11.28	12.13	19.90	15.74
May-95	47.30	11.49	12.54	20.21	16.05
Jun-95	49.22	11.95	13.07	20.82	16.43
Jul-95	50.57	12.40	13.16	21.73	17.19
Aug-95	51.79	12.69	13.49	22.85	18.11
Sep-95	52.32	12.67	13.79	23.60	18.61
Oct-95	54.09	13.20	14.02	24.00	18.72
Nov-95	54.40	13.41	13.96	23.62	18.13
Dec-95	56.67	13.85	14.67	24.51	18.86
Jan-96	57.36	14.09	14.89	24.14	18.65
Feb-96	59.08	14.57	15.27	24.51	18.77
Mar-96	59.75	14.68	15.51	25.11	19.24
Apr-96	60.48	14.67	15.60	25.38	19.61
May-96	60.63	14.75	15.59	26.47	20.70
Jun-96	62.01	15.25	15.77	27.10	21.37
Jul-96	62.64	15.51	15.80	26.47	20.68
Aug-96	60.34	14.96	15.21	24.72	19.07
Sep-96	60.89	14.96	15.49	25.63	19.94
Oct-96	63.99	15.90	16.08	26.87	20.67
Nov-96	65.45	16.23	16.49	26.52	20.39
Dec-96	70.50	17.44	17.80	27.89	21.39
Jan-97	68.02	16.79	16.97	25.92	20.05
Feb-97	72.67	18.25	17.81	27.09	20.70
Mar-97	73.59	18.52	17.99	26.67	20.22
Apr-97	70.09	17.55	16.96	24.87	19.08
May-97	73.77	18.76	17.54	25.21	19.38
Jun-97	78.34	19.92	18.63	27.71	21.54
Jul-97	82.32	21.03	19.48	28.94	22.42
Aug-97	87.62	22.43	20.69	30.85	23.66
Sep-97	85.93	21.79	20.49	31.52	24.50
Oct-97	88.36	22.27	21.20	33.32	26.05
Nov-97	86.93	22.04	20.73	32.52	25.34
Dec-97	90.37	23.08	21.40	32.36	24.93
Jan-98	90.50	22.70	20.88	30.71	23.73
Feb-98	93.01	23.81	21.01	30.75	23.61
Mar-98	97.47	24.83	22.13	32.64	25.11
Apr-98	102.82	26.32	22.90	34.24	26.23
May-98	104.10	26.46	23.36	34.54	26.24
Jun-98	101.47	25.75	22.81	32.39	24.42
Jul-98	106.68	27.87	23.23	33.44	24.83
Aug-98	103.42	27.48	22.11	30.88	22.37
Sep-98	92.57	25.07	19.36	25.88	18.87

DATE	S&P500 Index	Russell2000 Index	S&P500 Futures	Russell2000 Futures	US 90-Day Tr Yield	S&P500 Annualized Volatility	Russell 2000 Annualized Volatility
Dec-93	461.89	252.61	464.00	252.50	3.1%	7.10%	10.26%
Jan-94	465.44	256.53	465.90	257.50	3.0%	7.06%	8.83%
Feb-94	479.62	266.50	479.90	267.05	3.3%	6.18%	6.33%
Mar-94	464.44	264.34	463.90	262.55	3.5%	9.37%	8.75%
Apr-94	438.92	247.04	439.20	247.05	3.7%	10.99%	11.92%
May-94	453.02	254.04	452.80	254.60	4.1%	11.70%	15.38%
Jun-94	457.63	250.08	457.70	250.20	4.1%	12.23%	10.96%
Jul-94	446.20	241.12	446.50	240.70	4.3%	9.49%	9.60%
Aug-94	461.01	245.06	461.10	246.50	4.5%	8.89%	8.79%
Sep-94	473.17	256.06	473.80	256.35	4.6%	8.02%	5.86%
Oct-94	461.74	254.78	463.20	255.75	5.0%	9.00%	6.81%
Nov-94	468.42	253.48	469.10	253.70	5.3%	10.83%	8.61%
Dec-94	448.92	242.03	449.00	240.40	5.6%	11.19%	8.48%
Jan-95	459.11	247.24	461.40	249.30	5.7%	10.29%	11.57%
Feb-95	470.40	247.50	471.90	247.00	5.8%	7.39%	8.92%
Mar-95	485.65	256.05	486.10	257.05	5.7%	6.44%	7.47%
Apr-95	501.85	260.81	504.60	261.90	5.7%	7.04%	6.13%
May-95	514.26	265.94	515.30	266.40	5.7%	6.69%	4.88%
Jun-95	533.49	271.48	533.70	273.60	5.5%	8.18%	6.03%
Jul-95	547.09	283.74	549.50	286.00	5.4%	9.53%	6.49%
Aug-95	559.64	298.33	561.40	294.85	5.4%	10.13%	9.78%
Sep-95	563.84	306.17	564.90	305.80	5.3%	7.27%	8.94%
Oct-95	581.72	306.99	585.00	308.00	5.3%	5.73%	7.91%
Nov-95	584.21	297.70	588.20	299.25	5.4%	6.90%	10.30%
Dec-95	606.98	309.74	608.30	312.45	5.1%	7.73%	8.28%
Jan-96	620.74	316.81	625.10	320.75	5.0%	9.16%	8.99%
Feb-96	638.40	317.32	639.60	319.05	4.8%	11.14%	11.69%
Mar-96	644.36	324.10	647.20	323.40	5.0%	12.20%	8.22%
Apr-96	653.73	332.44	657.40	337.95	5.0%	13.74%	9.80%
May-96	654.58	350.28	656.40	352.75	5.0%	12.62%	7.37%
Jun-96	667.68	361.44	669.40	362.25	5.1%	10.87%	8.03%
Jul-96	675.87	347.72	680.80	350.25	5.2%	9.29%	10.38%
Aug-96	650.01	319.42	653.00	320.00	5.1%	13.08%	17.87%
Sep-96	654.73	333.37	655.80	332.00	5.1%	13.97%	15.60%
Oct-96	689.05	345.32	695.10	347.70	5.0%	10.05%	5.90%
Nov-96	703.76	339.76	706.50	340.25	5.0%	8.85%	6.65%
Dec-96	756.53	355.34	758.00	358.25	4.9%	7.81%	6.34%
Jan-97	736.99	358.96	744.70	365.00	5.0%	11.74%	8.88%
Feb-97	786.70	369.53	789.70	370.00	5.0%	12.98%	7.96%
Mar-97	795.31	360.49	795.20	360.10	5.1%	13.24%	6.82%
Apr-97	759.64	340.88	765.00	341.55	5.2%	14.84%	9.73%
May-97	798.53	345.66	802.00	349.25	5.1%	17.15%	12.29%
Jun-97	846.36	383.52	846.20	384.70	4.9%	17.98%	12.04%
Jul-97	891.03	394.13	901.20	397.90	5.1%	15.64%	7.25%
Aug-97	947.14	414.21	953.00	415.00	5.1%	14.50%	7.93%
Sep-97	927.57	428.05	933.50	429.25	5.0%	17.32%	9.30%
Oct-97	955.41	454.69	963.40	459.80	5.0%	17.13%	7.73%
Nov-97	938.99	440.97	945.70	444.60	5.1%	26.68%	21.76%
Dec-97	974.77	434.16	979.60	437.05	5.2%	26.61%	23.93%
Jan-98	975.00	436.52	984.70	441.25	5.0%	20.54%	15.08%
Feb-98	1001.28	434.44	1004.00	436.75	5.1%	16.89%	16.49%
Mar-98	1047.72	461.54	1050.10	462.50	5.0%	15.43%	13.71%
Apr-98	1108.13	484.93	1118.20	491.50	5.0%	10.69%	7.78%
May-98	1121.02	484.94	1129.60	489.50	5.0%	12.31%	12.40%
Jun-98	1090.98	451.17	1095.20	450.60	5.0%	12.16%	14.57%
Jul-98	1148.56	459.86	1156.40	464.60	5.0%	13.89%	13.91%
Aug-98	1112.44	413.36	1112.44	413.36	4.9%	15.60%	14.89%
Sep-98	994.24	348.11	994.24	348.10	4.6%	26.91%	27.49%

Market Index Returns:		
Style Benchmark		
	S&P500	**Russell**
MIN	**0**	**0**
MAX	**1**	**1**
199401	3.20%	3.02%
199402	-3.05%	-0.37%
199403	-4.68%	-5.60%
199404	1.15%	0.59%
199405	1.23%	-1.30%
199406	-2.72%	-3.67%
199407	3.33%	1.56%
199408	3.46%	5.29%
199409	-2.90%	-0.47%
199410	2.24%	-0.43%
199411	-4.03%	-4.31%
199412	1.22%	2.47%
199501	2.40%	-1.41%
199502	3.54%	3.86%
199503	2.70%	1.62%
199504	2.76%	2.05%
199505	3.57%	1.52%
199506	2.10%	4.83%
199507	3.13%	5.52%
199508	-0.03%	1.85%
199509	3.93%	1.65%
199510	-0.50%	-4.66%
199511	4.02%	4.08%
199512	1.73%	2.37%
199601	3.21%	-0.19%
199602	0.69%	2.98%
199603	0.79%	1.78%
199604	1.34%	5.16%
199605	2.26%	3.82%
199606	0.22%	-4.30%
199607	-4.68%	-9.24%
199608	1.86%	5.50%
199609	5.28%	3.67%
199610	2.58%	-1.69%
199611	7.08%	3.90%
199612	-2.17%	2.37%
199701	5.95%	1.87%
199702	0.59%	-2.58%
199703	-4.35%	-4.98%
199704	5.68%	0.13%
199705	5.69%	10.44%
199706	4.26%	4.03%
199707	7.52%	4.47%
199708	-5.92%	2.13%
199709	5.18%	6.93%
199710	-3.51%	-4.64%
199711	4.36%	-0.77%
199712	1.56%	1.64%
199801	1.01%	-1.61%
199802	6.81%	7.13%
199803	4.87%	4.00%
199804	0.90%	0.46%
199805	-1.90%	-5.60%
199806	3.87%	0.18%
199807	-1.16%	-8.59%
199808	-15.75%	-21.68%
199809	6.04%	7.28%

End Notes

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[1] H. Nicholas Hanson, "Options and Futures: New Route to Risk/Return Management", Options and Futures: Strategic Tools for Portfolio Management, Institute of Chartered Financial Analysts, 1984, p. 26

[2] Kolb, Robert W., Futures, Options, & Swaps, Blackwell Publishers Inc., Malden, MA, 1997, p. 256

[3] Sharpe, William F., "Asset Allocation: Management Style and Performance Measurement", Journal of Portfolio Management, Winter 1992, pg. 7 - 19.

In his study, Sharpe used a twelve asset class model to determine a fund's holding using a quadratic programming algorithm. In contrast to Sharpe's application, our sample consisted of five index equity funds that have a R^^{2} of greater than 92%. However, the purpose of this example was not an exercise in determining the equity style exposure, but show the impact of futures position on the style exposure of our sample portfolio.

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