

Passive Options-based Investment Strategies: The Case of the CBOE S&P 500 BuyWrite Index*

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ABSTRACT

This paper assesses the investment value of the CBOE S&P 500 BuyWrite (BXM) Index and its covered call investment strategy to an investor from the total portfolio perspective. Whaley [2002] finds risk-adjusted performance improvement based on the BXM Index in individual comparison to the S&P 500. We replicate this work with a longer history for the BXM Index and with the short but meaningful history of the Rampart Investment Management investable version of the BXM. We use the Stutzer [2000] index and Leland's [1999] alpha to assess risk-adjusted performance taking the skew and kurtosis of the covered call strategy into account. Additionally, we compare standard investor portfolios to portfolios where BXM has been substituted for large cap assets and find significant risk-adjusted performance improvement.

The compound annual return of the BXM Index over the almost 16-year history of this study is 12.39%, compared to 12.20% for the S&P 500. Risk-adjusted performance, as measured by the Stutzer index, is 0.22 for the BXM versus 0.16 for the S&P 500 [monthly]. Leland's alpha is 2.81%/yr. The tracking error of the Rampart investable version of the BXM (1.27%/yr) is found to be credible evidence of the investability of the BXM Index.

Known sources of BXM return are reviewed and behavioral factors that may have enhanced BXM performance are considered.

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This paper studies the investment properties of the covered-call investment strategy embodied in the CBOE S&P 500 BuyWrite (BXM) Index published by the Chicago Board Options Exchange (CBOE). We expand on Whaley [2002]: by using the now longer available history for the index; by analyzing the investment performance record of the Rampart Investment Management BXM, an investable version of the index; and by studying the impact of including the BXM in standard investor portfolios. Further, we consider explanations for the profitability of the strategy. In addition to studying the BXM, we consider the implications of the BXM's performance record for passive investment more generally.

As long-term return expectations continue below those experienced during the 1990s, investor interest in increasing returns by reducing unnecessary management fees and new technology is driving a polarization of investment strategies. Traditional active management is increasingly challenged, on one side by inexpensive passive strategies and on the other by incentive compensation-based alternatives such as hedge funds. Passive indexed investment strategies now represent well over \$1 trillion in global capitalization and are growing considerably more quickly than the approximately \$13 trillion in active or semi-active mutual funds.

Index funds and index-based ETFs are examples of low-cost passive investment vehicles. The CBOE BXM Index is an example of a passive benchmark index designed to reflect the buying an asset and selling—or writing—one-month at-the-money calls, a rules-based “covered

call” investment strategy.¹ The Rampart Investment Management investable version of the BXM has been available since January 1, 2003 and has management fees of 50 basis points or less.

The basic question addressed in this paper is whether the CBOE BXM strategy should be of interest to investors. This question raises three issues. First, how much contribution to risk-adjusted portfolio performance would the BXM have made based on the *pro forma* results reflected in the CBOE BXM Index? Second, could similar performance have been expected of investable versions of the index? And third, given that BXM performance has been very good and it appears that investable versions are able to match the performance of the index, can this relative performance be expected to continue in the future? Our answers to these questions imply that investors should indeed be interested in the BXM strategy.

These conclusions raise the larger issue of whether passive rules-based investment strategies should be of interest to the general investing public. The weakest form of market efficiency obtains when prices reflect the information in available statistical data. Weak market efficiency would seem to imply that no rules-based strategy based on public financial data should be expected to improve risk-adjusted performance, since this is the only information rules-based strategies can use.

The BXM is an exceptional rules-based strategy in as much as it requires no information at all. At-the-money calls are written on the S&P index. If the BXM can add to risk-adjusted performance then, in principle, more complex rules-based strategies can as well. In this sense, this paper is a case study on the viability of passive rules-based strategies.

¹ Other rules-based investment strategies include Merrill Lynch’s TRAKRS, Powershares Capital Management’s Powershares, and the Janus enhanced index funds managed by INTECH.

This paper continues as follows. Section 1 describes the construction of the CBOE BXM Index. Section 2 examines the investment performance of the CBOE BXM and a set of standard asset classes over the almost 16-year life of the BXM index. The BXM is found to have the best risk-adjusted performance of all equity-based instruments, both before and after controlling for the possible effects of the skew and kurtosis of the BXM index. The compound annual return of the CBOE BXM over its history is 12.39%, slightly higher than the 12.20% achieved by the S&P 500. The annualized standard deviation of the CBOE BXM, however, is only 10.99% as against the 16.50% of the S&P 500. The CBOE BXM has better risk-adjusted performance, both as measured by the Sharpe Ratio and the Stutzer [2000] index. Leland's [1999] alpha for the CBOE BXM is 2.81%/yr, only slightly lower than the Jensen's alpha of 2.93%/yr. The Stutzer index is a generalization of the Sharpe Ratio that takes non-standard distributional properties of asset returns, such as skew and kurtosis, into consideration. Leland's alpha is a measure of excess return that similarly adjusts for non-standard distributional properties. Control for these properties is particularly important when assessing the performance of options-based strategies.

Section 3 considers the shorter history covered by the Rampart BXM investable version of the index. Over this period, which corresponds closely to 2002–2003 market recovery, the BXM is outperformed by both the Russell 2000 and the MSCI EAFE indexes on a risk-adjusted basis. More important for this study, however, is the finding that the Rampart BXM tracked the CBOE BXM very closely and was, in fact, able to achieve better risk-adjusted return than the BXM and the S&P 500. The annualized tracking error of the Rampart BXM against the CBOE BXM is 1.28%. On the basis of cumulative annualized return, the Rampart BXM outperformed the

CBOE BXM by 23 basis points, while achieving a standard deviation 23 basis points lower. These results appear to clearly demonstrate the investability of the CBOE BXM.

Section 4 studies the changes in the performance of standard investment portfolios when BXM is substituted for investment in the S&P 500. Either 10% or 15% of the S&P 500 allocation is replaced by BXM in standard Ibbotson portfolios for conservative, moderate, and aggressive investors. Risk-adjusted performance is improved in all cases. Mean-variance analysis demonstrates a very considerable expansion of the efficient frontier when BXM is added to portfolio choices.

Section 5 studies the performance of the BXM relative to other assets in up and down markets. First, statistics for up months and down months are computed separately. Then the largest run-up and drawdown are studied. This section demonstrates that BXM does have superior performance in down markets. It also provides a clearer picture of the nature of BXM underperformance in up markets.

In Section 6, the strong risk-adjusted performance of the BXM strategy is discussed in the context of the persistent high observed relative implied volatility for index options. A number of factors, including the recent hypothesis that volatility is a priced factor and behavioral considerations, suggest that the BXM strategy will continue to outperform.

1. Construction of the BXM Index

The CBOE BXM Index measures the performance of a simple covered call strategy implemented on the S&P 500 index. In the covered call strategy, calls are written on an asset the

investor owns (or buys). In the case of the BXM, every month, one month just-out-of-the-money calls on the S&P 500 are written covering all the index shares owned. These calls replace expiring calls from the previous month.

The monthly return to the BXM strategy, $R_{BXM,t}$, is the ratio of the change in net value of S&P index and call holdings to the value of last month holdings. If the value of the S&P 500 index at time t is SP_t and the dividends received at time t are D_t , the change in value of the index holdings is $SP_t + D_t - SP_{t-1}$. If the price of the call at time t is C_t , the value of the call to the call writer is $-C_t$. Thus the change in the value of call holdings is $-(C_t - C_{t-1})$. The value of the portfolio at the end of the last period is then $SP_{t-1} - C_{t-1}$, and thus the total return to the BXM strategy is

$$R_{BXM,t} = \frac{(SP_t + D_t - SP_{t-1}) - (C_t - C_{t-1})}{SP_{t-1} - C_{t-1}}.$$

The value of a call at expiration is zero if the S&P 500 special opening quotation price is below the strike price of the option X_t and $SP_t - X_t$ otherwise.

Whaley [2002] describes the construction of the BXM index in detail. It is based on historical data on S&P 500 options prices going back to June 1, 1988 obtained from the CBOE. During the time period covered by this study, the bid price is conservatively used to determine the price received for writing the call.² S&P 500 settlement prices are used to determine the value of the expiring call. Like most index benchmarks, the BXM index does not specifically factor in

² In June 2004, the CBOE modified the pricing procedure; see www.cboe.com/bxm.

transaction costs or taxes, but the fact that the new calls were sold at the lower bid price helps the BXM Index to more closely reflect achievable returns.³

2. Comparative performance analysis

The BXM strategy will be compared to five asset classes over two time periods. The shorter time period corresponds to the available history for the Rampart Investment Management BXM and is studied in Section 3. This section covers the period from June 1, 1988 to March 31, 2004, the available history of the CBOE BXM Index.

The asset classes used in this study are large cap equities, small cap equities, international equities, bonds, and cash. The proxies for these asset classes are, respectively, the S&P 500, the Russell 2000, the MSCI EAFE (Europe, Australasia, and Far East) Index, the Lehman Brothers Aggregate Bond, and the Ibbotson U.S. 30 Day Treasury Bill Index. Statistics are based on monthly total returns. (Table 11 presents annual returns.)

Figure 1 shows the cumulative value over time of a dollar invested in the CBOE BXM and all asset classes on June 1, 1988. The March 31, 2004 values are \$6.36 for the CBOE BXM, \$6.19 for the S&P 500, \$5.33 for the Russell 2000, \$2.12 for EAFE, \$3.61 for the LB Aggregate Bond, and \$2.06 for cash. In general, it can be seen that the S&P 500 significantly outperformed the BXM strategy in the late 1990s, but lost several years of increasing relative advantage in a matter of months.

³ Taxable investors should be aware that covered call strategies are subject to complex tax rules (see, e.g., www.cboe.com/tax) and that the BXM and certain other covered call strategies may not be tax-efficient.

Figure 2 shows the compound annual rates of return implied by the cumulative values reported over this entire time period. Investment in the CBOE BXM grew at an average rate of 12.39%, slightly greater than the 12.20% achieved by the S&P 500. All other asset classes performed significantly worse over this time period.

Table 1 shows that that the average arithmetic returns of the BXM, the S&P 500, and the Russell 2000 are quite similar over the June 1, 1988 to March 31, 2004 period. Returns are just over 1% per month for each, and the annualized returns range from 12.93% for the CBOE BXM to 13.40% for the S&P 500. Table 1 also shows that their standard deviations are very different, running, on an annualized basis, from 10.99% for the CBOE BXM to 20.73% for the Russell 2000. The much higher standard deviation of the Russell 2000 explains why its cumulative performance is inferior to the BXM and the S&P 500 even though average returns are very similar. The performance of international assets over this time period is also not good. Figure 3 displays standard deviations graphically.

The Sharpe Ratio is a standard measure of risk-adjusted performance. Table 1 shows that the monthly Sharpe Ratio for the CBOE BXM is 0.225, in contrast to 0.159 for the S&P 500 and 0.121 for the Russell 2000. The CBOE BXM is has the clear risk-adjusted performance advantage according to Sharpe Ratios. Table 1 implies a 42% risk-adjusted performance advantage of the CBOE BXM over the S&P 500 and a much greater performance advantage over the other equity asset classes.

The superior implied performance of the CBOE BXM, based on Sharpe Ratios, however, might be biased because of the higher levels of skew and kurtosis for the BXM reported in

Table 1.⁴ The Sharpe Ratio assumes that returns are approximately normally distributed. Non-normality in asset returns can lead to biased Sharpe Ratios.⁵ Clearly, the payoff profile of the covered call strategy inclines the BXM to negative skew and higher kurtosis. Both result naturally from the truncation of large positive returns resulting from the covered call strategy. Figure 4 shows the estimated empirical density functions for both the S&P 500 and the CBOE BXM. The narrower and higher density of the BXM reflects its lower standard deviation. The larger left “tail” is indicative of the negative skew. The sharp falloff on the right tail reflects the clipped upside potential from calls that expire in-the-money.

In order to obtain unbiased estimates of risk-adjusted performance, we employ a generalization of the Sharpe Ratio, the Stutzer [2000] index. This index provides unbiased estimates of risk-adjusted performance even when skew and kurtosis are present. The Stutzer index may be used and interpreted in the same way as the Sharpe Ratio. When an asset’s returns are normally distributed, the Stutzer index is equal to the Sharpe Ratio. See Appendix A for more information on the Stutzer index.

Table 1 shows that the adjusted-performance advantage of the CBOE BXM persists when using the Stutzer index to measure risk-adjusted performance. The relative performance advantage in comparison to the S&P 500 declines from 42% to 37%, which is still a quite significant performance advantage. Stutzer index values are presented graphically in Figure 5.

⁴ Skew is the tendency for large returns to be biased positive or negative. Negative skew implies that large returns are more likely to be negative than positive. Kurtosis compares the relative frequency of large returns to small returns to the relative frequency of the normal distribution. High kurtosis, or “fat tails” signals that large returns with very low probability of occurring when returns are normally distributed may be much more likely to be realized.

⁵ Till (2001) provides an excellent and accessible discussion on this point.

Jensen's alpha, reported in Table 1 as 2.93% per year for the CBOE BXM is another standard measure of risk-adjusted performance. It is the return of an asset in excess of that predicted by the CAPM. Similar to the Sharpe Ratio, Jensen's alpha may be biased if returns are not approximately normally distributed. Leland's [1999] alpha remains unbiased even if returns are not normally distributed. Leland's alpha is found to be 2.81% per year for the CBOE BXM.

Results based both on the Stutzer index and Leland's alpha indicate that the non-normality induced by writing calls does not significantly affect CBOE BXM risk-adjusted performance.

3. Performance of the Rampart investable BXM strategy

This section reports on the performance of the Rampart Investment Management investable version of the BXM Index. The fundamental result is that the Rampart BXM tracks the CBOE BXM closely over its 15 months of history.

Table 2 shows the performance of asset class benchmarks, the CBOE BXM, and the Rampart BXM over the period January 1, 2003 to March 31, 2004. All performance is reported on a before-fee basis.⁶ Over this period, the S&P 500 outperforms the CBOE and Rampart BXM. On an annualized basis, the S&P 500 gained 24.63% with a standard deviation of 13.04%. The Rampart BXM investable index returned an annualized 17.26% at a 9.04% standard deviation.

⁶ Rampart Investment Management charges 50 basis points for investments under \$25 million and 25 basis points for incremental investments over \$50 million. These fees are somewhat greater than what an institutional investor might pay for an S&P 500 index fund of comparable size, but they are comparable to fees for other types of index funds.

The CBOE BXM performance is very similar. The Sharpe Ratios show the S&P 500 with a small risk-adjusted performance advantage (3.74%) against the Rampart BXM.

Table 3 reports monthly performance before expenses. The monthly tracking error is 0.37%, which annualizes to 1.28%. While this is greater than the tracking of well-managed index funds, it is at the lower range of tracking error for enhanced index funds.⁷

Interestingly, this period was a period of positive skew in the S&P index, but of greater positive skew for the BXM covered call strategy. As a result, when measuring performance by the Stutzer index, the Rampart BXM has a slender (0.7%) performance advantage over the S&P 500. Even in an upward trending market where the covered call strategy is at a natural disadvantage, the BXM still does very well on a risk-adjusted basis. Note also, the levels of autocorrelation reported for BXM in Tables 1 and 2 are low. The level of autocorrelation is important in inferring long-term risk. High positive autocorrelation implies understated long-term volatilities (see Lo [2002]) that require adjustment. The levels of autocorrelation observed here do not indicate significant levels of bias.

4. Portfolio analysis

The practical benefits of all potential investments are best understood in the context of an investor's portfolio. This is the only way that the diversification potential of an investment can be properly understood. This section studies the impact of adding BXM to three standard

⁷ Frino and Gallagher (2001) report a mean *monthly* tracking error of 0.06% for a sample of S&P 500 index funds. Jorion (2002) reports a mean annual tracking error of 2.24%/yr for a sample of 45 enhanced index funds. Less than 25% of these funds had an annual tracking error of 1.57% or less and less than 5% had a tracking error of 0.79% or less.

investor portfolios. These portfolios are shown in Table 4 and are recommended by Ibbotson Associates to long-term investors investing in the five basic asset classes included in this study. There is a conservative, moderate, and aggressive portfolio. The conservative portfolio is 20% equity, the moderate portfolio is 60% equity, and the aggressive portfolio is 95% equity.

4.1 Portfolio analysis: June 1988 to March 2004

Table 5 shows the performance of these portfolios over the June 1, 1988–March 31, 2004 study period. These results are consistent with market performance over this period.

Table 6 shows the performance of the three model portfolios with allocations to large cap replaced with 15% allocation to BXM. The annualized return for the conservative portfolio drops 7 basis points, from 7.85% to 7.78%, as the entire 15% allocation to large cap is replaced with BXM. The annualized standard deviation drops 73 basis points, from 3.92% to 3.19%. The annualized Sharpe Ratio increases from 0.818 to 0.988. The Sharpe Ratio, however, does not take account of the modest observed increases in negative skew and excess kurtosis. The monthly Stutzer index, however, does. It rises from 0.237 to 0.283, a change very similar to the change in the monthly Sharpe Ratio. The results for the Ibbotson moderate and aggressive portfolios show a repetition of the patterns observed for the conservative portfolio. There are under 10 basis point declines in annualized return coupled with approximately 90 basis point declines in annualized volatility. This results in an increase in risk-adjusted performance, whether measured by the Sharpe Ratio or the Stutzer index.

4.2 Portfolio analysis: January 2003 to March 2004

Performance over the period January 1, 2003 to March 31, 2004, the complete history of the Rampart investable BXM Index, is considered in this subsection. Tables 7 and 8 report the performance of the conservative and aggressive Ibbotson consulting portfolios and the effect of adding 15% CBOE or Rampart BXM to these portfolios. Over this period, the decline in return is much greater than over the complete history. This is not surprising given the very strong performance of equity assets over this period.

Table 7 shows the results for conservative portfolios. Annualized return drops approximately 100 basis points. Annualized standard deviation, however, drops by more than 50 basis points. By all indicators, the risk-adjusted return of the conservative portfolio still increases with the addition of BXM. The risk-adjusted return of portfolios with CBOE BXM is slightly better than the performance of portfolios with Rampart BXM. This result is interesting as Table 2 shows the Rampart BXM has slightly better mean and standard deviation and risk-adjusted performance compared to the CBOE BXM.

In Table 8 it can be seen that the drop in annualized return for the aggressive portfolio is more than 110 basis points and the decline in annualized volatility is about 80 basis points. Again, risk adjustment by either measure indicates an increase in risk-adjusted return with the addition of either CBOE or Rampart BXM.

The year 2003 was the first year of positive S&P 500 returns since 1999. The years 2000 through 2002 were the longest string of consecutive large cap losses since 1941, and only the great depression itself produced a longer string of losses in the record of S&P performance

(cumulative losses 1929–1932: 64.22%, 1939–1941 20.57%, and 2000–2002 37.61%). It is hard to imagine a tougher environment than 2003 for the covered call strategy.

4.3 Mean-variance analysis

Figure 6 presents the mean-variance efficient frontiers based on the 1998 to 2004 time period. The inner frontier is generated by using only conventional assets. The outer frontier results from the addition of CBOE BXM. It can be seen that BXM significantly expands the efficient frontier. The skew and kurtosis of the BXM indicate that the mean-variance frontier may somewhat overestimate the expansion of the true efficient frontier. However, the relatively close agreement of the Sharpe Ratio and Stutzer index suggest that this overestimation is relatively small. Note that realization of these performance gains is dependent on having, in some cases, very large levels of BXM holdings.⁸

Sensitivity studies were conducted with BXM returns reduced by 100, 200, and 300 basis points. Allocations did not change appreciably with a 100 basis point reduction in return, strongly suggesting that neither taking expenses into account nor some decline in future relative performance would alter the basic pattern of results described here. A 200 basis point reduction in BXM performance led to inclusion of up to 16% BXM in optimal portfolios. Even after a 300 basis point reduction in BXM performance, a 6% allocation to BXM was found to be optimal for more conservative investors.

⁸ The corner at approximately 11% standard deviation represents a portfolio of 100% BXM.

5. BXM performance in up and down markets

The BXM covered call strategy forgoes upside potential above the strike price in return for the downside cushion of the call premium. The strategy should be expected to enhance returns in bear markets, but lower returns during bull markets. This section analyzes the performance of the CBOE BXM and its effects on investor portfolios during market upturns and downturns as defined by the performance of the S&P 500. Looking at market downturns helps in the assessment of the efficacy of the covered call strategy in providing downside cushion. The study of market upturns provides insight into the extent of the truncation of upside potential.

Two separate definitions of market upturns and downturns are used.

5.1 Market state definition 1: Monthly performance condition

Under the first definition, a market downturn is identified as any month where the S&P 500 returned -2.0% or less. That is, the BXM and portfolio performance statistics were generated conditional on the S&P 500 returning -2.0% or less during the month. Conversely, a bull market or upswing is defined as the S&P 500 returning 2.0% or more during the month.

Results:

Table 9 shows that between June 1988 and March 2004 there were 41 months when the S&P 500 returned -2% or less. The monthly arithmetic mean return over those 41 months for the S&P was -4.9% , whereas the arithmetic mean return for the BXM over the same 41 months was -2.5% . On average, about 230 basis points less was lost with the covered call strategy than with the S&P 500, albeit, perhaps surprisingly, with slightly higher standard deviation. This result is reflected in the model portfolios where the portfolios with a 15% allocation to BXM lost about 35 basis points less on average than the model portfolios without BXM during these periods.

The monthly standard deviation of conservative portfolios with BXM during these months was 0.71%, as compared to 0.57% for the standard conservative portfolio.

During the same period there were 81 months when the S&P 500 returned 2% or more (bull market). We can see from Table 10 that, on average, the S&P 500 outperformed the BXM by about 182 basis points per month over these 81 months.

5.2 Market state definition 2: Large drawdown and run-up

The second definition identifies bull and bear markets by the magnitude of the drawdown or run-up. A single large run-up and drawdown are identified as representative of bull and bear markets, respectively. The largest drawdown is identified as the period from September 2000 to September 2002, when the S&P 500 declined 44.7%. The period from September 1998 to March 2000 is identified as one of the largest run-ups when the S&P 500 rose almost 60%.⁹

Results:

The results in Figure 7 confirm our observation under the first definition that the covered call strategy provides significant downside protection during bear markets. Over the 25 months of the drawdown, the S&P 500 had a compound return of -2.3% per month. BXM performance was about 90 basis points better with a monthly compound return of -1.4% . This translates to a cumulative loss of about 15 cents less on the dollar vis-à-vis the S&P (see Figure 7).

Consequently, the conservative portfolio with a 15% allocation to BXM had a cumulative gain of about 4 cents more on the dollar than the regular conservative portfolio, and the aggressive portfolio with 15% BXM had a cumulative loss of about 2 cents less on the dollar than the aggressive portfolio without BXM.

⁹ The entire period is assumed to be a run-up even though there were minor intermittent declines.

The results for the 19 months of the bull market from September 1998 to March 2000 show that the compound average return on a monthly basis for the S&P was approximately 2.5% as opposed to 2.25% for the BXM. This translates to a cumulative gain of about 8 cents less vis-à-vis the S&P over the entire 19 months (see Figure 8). Consequently, the portfolios with 15% BXM gain about 1 cent less on a cumulative basis than the portfolios without BXM.

6. Should the BXM's relative performance be expected to continue?

The results developed here demonstrate that a modest investment in the BXM strategy would have provided a significant improvement in risk-adjusted return for typical investor portfolios and that investable versions of the BXM should have been able to deliver the performance of the BXM Index. It is not clear that the relative performance of the BXM strategy should be expected to continue in the future. This section reviews some issues relevant to making such an assessment.

The value of covered-call investment strategies has been studied by practitioners¹⁰ and academics. Many academic studies that assume options are priced according to the Black Scholes [1973] model find little or no risk-adjusted performance gain.¹¹ This literature might seem to call into question the results of this study. However, recent studies based on actual options prices have found that option writing can be very profitable.¹² The profitability in option

¹⁰ See, for example, Hill and Gregory (2002), Moran (2002), and Stux and Fanelli (1990).

¹¹ Merton, Scholes, and Gladstein (1978) use simulation based on Black Scholes pricing and find potential benefits to covered call investing. Rendleman (2001) finds only narrow conditions under which an investor's risk preferences will cause them to write calls when options are priced according to Black Scholes. Leland (1999) shows that a covered call strategy implemented with Black Scholes-priced options has zero adjusted (Leland's) alpha. Section 3 of this study shows that the BXM Index has substantial Leland's alpha.

¹² See, particularly, Bollen and Whaley (2004), and Bondarenko (2003, 2004).

writing is related to the fact that option “implied volatility” is consistently higher than subsequently realized volatility.¹³

6.1 Implied volatility higher than realized volatility

Implied volatility over the term of an option is inferred from its price using an options pricing model such as Black Scholes [1973]. Realized volatility is the actual volatility of the underlying asset over the same term that is subsequently observed. If the model is correctly pricing the option, the average difference between implied and realized volatility should be small over long periods of time. It is well-known that implied volatility is consistently and significantly higher than realized volatility for many index options [see Stux and Fanelli [1990], Schneeweis and Spurgin [2001], and Whaley [2002]]. This means that options prices are consistently higher than those inferred by the model. A strategy of writing options that have consistently high relative implied volatility could then earn a superior risk-adjusted return.¹⁴

Over the period of this study, implied volatility averaged 16.53%, while realized volatility averaged 14.88%. The average difference of 1.64% is statistically greater than zero at the highest probability levels ($p < 1.2 \cdot 10^{-6}$).¹⁵ Since the call premium is strongly positively related to implied volatility, the persistent greater than 10% excess implied volatility reflects a significant price premium to call writers. Call premiums are, of course, the key determinant of BXM performance. Over the period of this study call premia have averaged 1.69% a month with a

¹³ Bollen and Whaley (2004) present a review of the Black-Scholes mispricing literature.

¹⁴ Bondarenko (2003) finds that writing one-month at-the-money puts on S&P 500 futures has a Jensen’s alpha of 23% *per month* (standard deviation 113%).

¹⁵ Volatility data were obtained from CBOE and compiled by Whaley (2002) and by Merrill Lynch Global Equity-Linked Research.

standard deviation of 0.69%. Annualized, this translated to a 22.31% premium with a standard deviation of 2.86%. Figure 9 displays monthly premia over the study period. The persistence and stability of the differential between implied and realized volatility is key to the continuation of BXM relative performance.

6.2 Negative volatility premium

One proposed explanation for the high levels of relative implied volatility is the existence of a negative volatility risk premium (Bakshi, Cao, and Chen [2000], Bakshi and Kapadia [2003], Bondarenko [2004]). This would mean, essentially, that people are willing to pay to hold volatility. This might be the case, for example, if volatility is desirable to hold because it is negatively correlated with market returns. Bondarenko [2004] notes that many hedge fund strategies are considered to be “short volatility” strategies. He finds that treating volatility as a priced risk factor and adding it to factor pricing models of hedge fund performance greatly increases the explanatory power of these models and reduces the risk-adjusted return of most hedge fund strategies. These results are consistent with a negative volatility risk premium. Statistical tests of the hypothesis of a negative volatility risk premium are inconclusive at this time (Branger and Schlag [2004]).

6.3 Supply and demand for optionality

A perhaps simpler perspective for thinking about options prices is the supply and demand for optionality. This perspective is similar to the Ibbotson, Diermeier, and Siegel [1984] approach to the supply and demand for asset returns. In the options context, this framework is simply the proposition that the demand for the call option to participate in market upswings is high relative to the willingness of call writers to supply this optionality (and similarly for the demand for put

to protect against market downturns). This perspective finds support from Bollen and Whaley [2004], who find that an option's implied volatility at a point in time is significantly affected by the net demand for the option.

Bollen and Whaley [2004] document what might be called clientele effects. For example, the departures from Black Scholes pricing are different for index options as compared to options on individual stocks, and these differences cannot be reasonably explained by the difference in the distributional properties of the returns. For example, they find that institutional demand for insurance in the form of far out-of-the-money S&P index-puts drives up the associated implied volatilities.

6.4 Behavioral considerations

Bollen and Whaley, however, do not address long-term determinants of the supply and demand for optionality. The buyers of call options have optimistic expectations of future performance. One possible explanation for the relative performance of the covered call strategy is that call buyers systematically overestimate the value of the call.

Overestimating call value is consistent with overconfidence and confirmatory bias, two well-documented behavioral tendencies (see Rabin [1998]). Call purchasers are among the most confident of all investors. Their purchase will expire worthless unless the strike price is hit. Call purchasers often have strong expectations of future economic performance and are looking for leveraged investment performance. Behavioral research demonstrates that the more confident people are, the more likely they are to discount evidence contrary to their beliefs. The most confident investors are thus those who may be expected to have the most biased expectations.

The behavioral economist might then logically expect to see consistent pricing pressure in the direction of the observed upward bias in implied volatility.

A mirror argument to that made for call purchasers can be made for put purchasers. The consequence of these observations is that we should expect the effects of any heterogeneity in investor expectations to be amplified in options markets relative to asset markets generally. If this behavioral explanation for observed options prices is indeed correct, part of the return of the BXM strategy is the monetization of this overconfidence bias.

6.5 Time decay

An important feature of the BXM strategy is that it is based on short-dated options. One reason for this is the time decay property of options, also known as *theta*. The closer an option comes to expiration, the less valuable it becomes, other factors being equal. Further, the closer it comes to expiration, the more quickly its time value decays.¹⁶ Because of this, the expected total premium from writing 12 consecutive at-the-money one-month calls is approximately twice the expected premium from writing four consecutive at-the-money three-month calls, other factors being equal.¹⁷

6.6 Summary

The strong risk-adjusted performance of the BXM Index is consistent with recent findings regarding the options prices more generally. The persistent observed high relative implied volatility for index options and the hypothesized negative volatility risk premium are two

¹⁶ Hull (2000) provides a systematic treatment of option theory.

¹⁷ The greater premia earned from shorter-dated options, however, does not guarantee that a strategy based on short-dated options will perform better. The probability of losses due to option expiration in the money increases as well. It is an empirical, as opposed to a theoretical question, as to which should be more profitable.

potential explanations for observed out-performance. These explanations are complementary with the idea that options markets should be more sensitive to heterogeneity in investor views and, thus, to biases due to fear and overconfidence. To the degree that fundamental considerations such as these do explain the BXM strategy's relative performance, such out-performance should be expected to continue in the future.¹⁸

7. Conclusion

This study shows the BXM Index, a benchmark for an S&P 500-based covered call strategy, had slightly higher returns and significantly less volatility than the S&P 500 over a time period of almost 16 years, despite the fact that covered calls have a truncated upside in the short term. The CBOE BXM Index is found to have been an effective substitute for large-cap investment that improved the risk-adjusted performance of standard investment portfolios, and that it is reasonable to conclude that investable versions would have substantially replicated the performance of the index. It is also determined that the BXM strategy would still have been a very desirable investment when its return was reduced by 100 basis points. Further, several fundamental considerations have been identified that might explain the relative performance of the BXM strategy. These conclusions, together with the likelihood that any changes in the relative performance of the BXM will evolve slowly over time, lead to the assessment that the BXM strategy is a prudent investment option worthy of investor attention.

¹⁸ It could be that the success of the strategy would significantly increase the supply of ATM calls and reduce the profitability of the strategy. Given the popularity of the covered call strategy, this decline in profitability should already be visible in the BXM Index. No time series trend is observable call premia.

Perhaps the primary investor concern regarding the BXM strategy is that it employs options and that options are derivatives and some derivative strategies are quite risky. The BXM Index clearly had significantly less volatility, as measured by the standard deviation of returns, than key stock indexes. By computing risk-adjusted returns with the Stutzer index and Leland's alpha, we demonstrate that the level of skew and kurtosis present in BXM returns does not materially affect BXM performance.

Appendix A: The Stutzer Index

Stutzer [2000] devised a statistic to take skew and kurtosis into account based on large deviation theory. This statistic is related to the probability that the average return of an asset will fall below a reference level. The Stutzer information statistic I_p is the maximum value of the expression shown in the following equation:

$$[A.1] \quad I_p = \max_{\theta} \left\{ -\log \left(\frac{1}{T} \sum_{i=1}^T e^{\theta r_i} \right) \right\},$$

where $\{r_i\}$, $i = 1, 2, \dots, T$, is an excess return series of T observations and θ is a parameter to be adjusted to maximize I_p . The Stutzer index is based on the Stutzer statistic and determined by the following relation:

$$[A.2] \quad \text{Stutzer ratio} = \text{sign}(\bar{r}) \sqrt{2 I_p}.$$

where $\text{sign}(\bar{r})$ is the sign of the mean excess return. The excess return is typically with respect to the risk-free rate. In this case, when the returns $\{r_i\}$ are normally distributed, the Stutzer index has the same expected value as the Sharpe Ratio. Excess returns may be formed against any benchmark and then the interpretation is the same as the information ratio.

The Stutzer information statistic has an interpretation in terms of large deviation theory. The probability that \bar{r} is less than or equal to zero is approximately

$$[A.3] \quad P(\bar{r} \leq 0) \approx \frac{c}{\sqrt{T}} e^{-I_p T},$$

where c is a constant related to the distributional characteristics of the asset. Note that if returns are in logarithmic form, then equation [A.3] relates to the approximate probability that the *cumulative* excess return will be less than zero.

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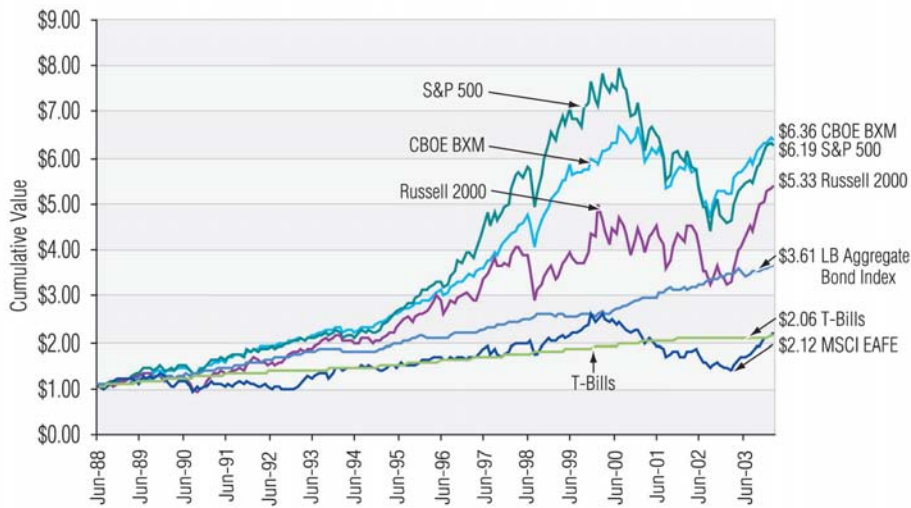


Figure 1: The value of a dollar invested on June 1, 1988. Cumulative returns for all asset classes in this study. The cumulative values of the CBOE BXM and the S&P 500 are closely related. As of March 31, 2004 the value of one dollar invested in CBOE BXM was \$6.36 while a dollar invested in the S&P 500 was worth \$6.19.

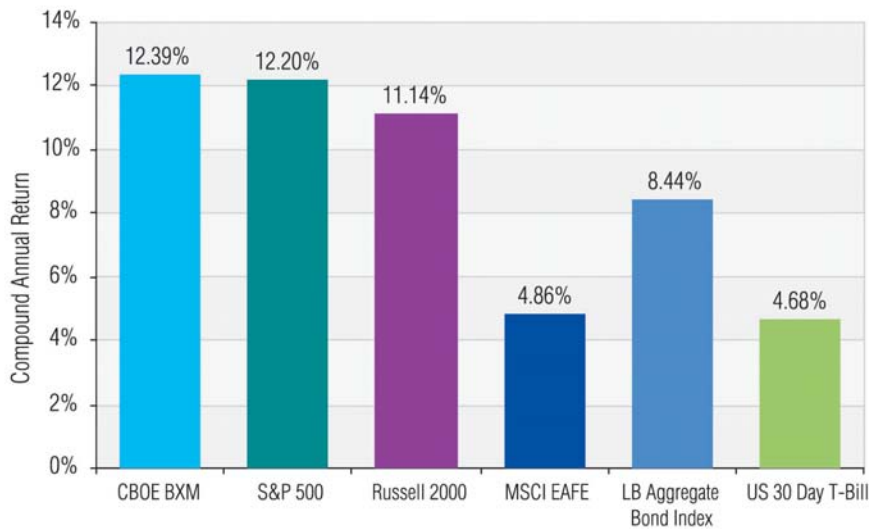
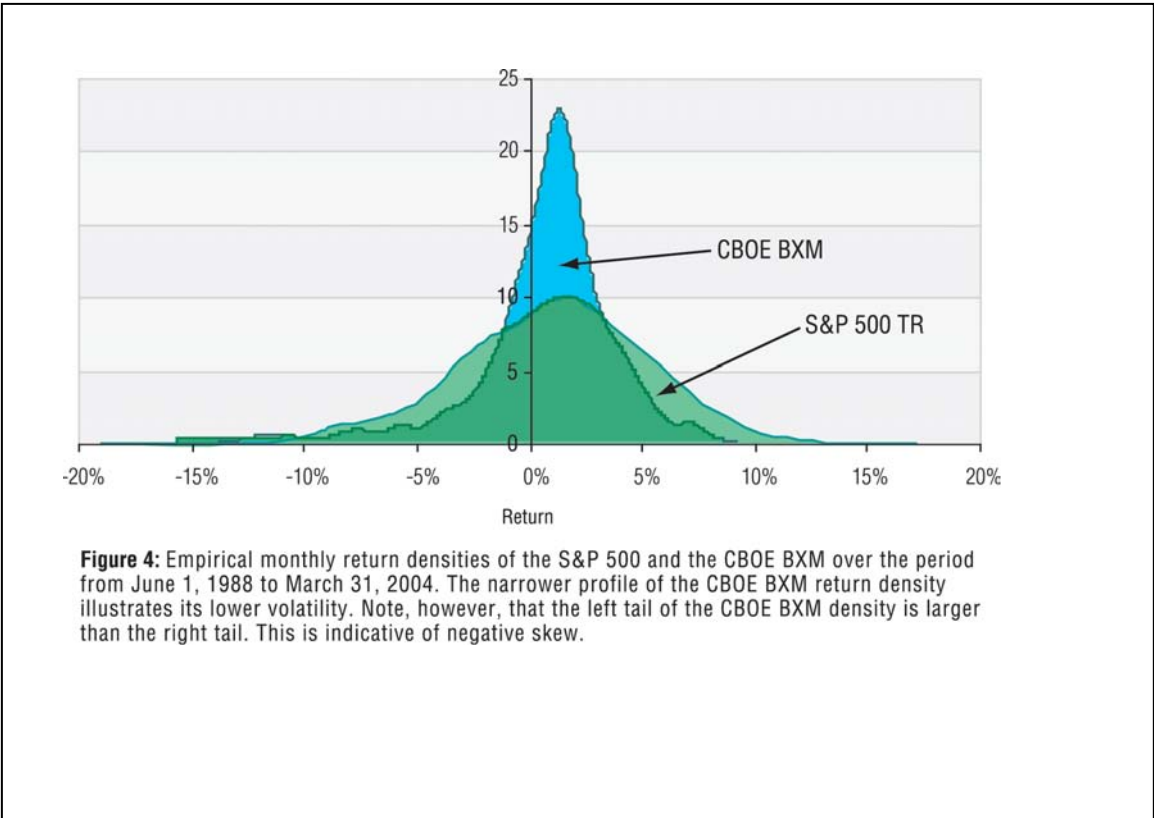
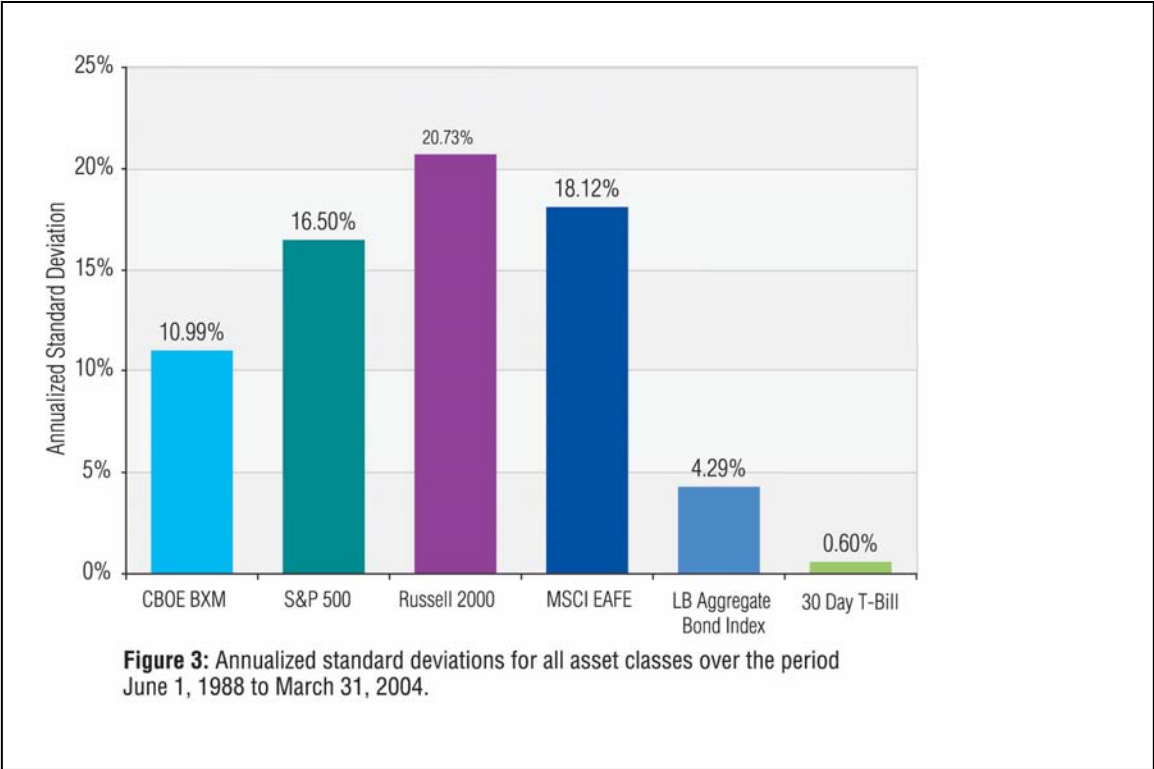


Figure 2: Compound annual returns or annualized returns for all asset classes over the period June 1, 1988 to March 31, 2004. Compound annual returns depend only on the beginning and ending values of the indexes and the elapsed time period. The growth rate of 12.39% for the CBOE BXM indicates that one dollar growing at this constant rate would have grown to \$6.36 over the study period. Note that the CBOE BXM compound annual growth rate is slightly higher than that for the S&P 500.



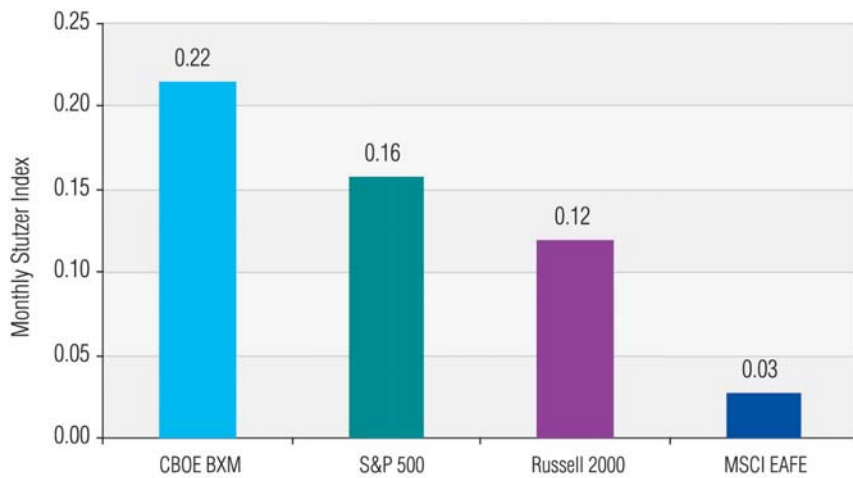


Figure 5: Monthly Stutzer index values for equity indexes, data from June 1988 to March 2004. The Stutzer (2000) index is measure of risk-adjusted returns. It is a generalization of the Sharpe ratio that controls for skew and kurtosis in asset returns (see Appendix A). The results indicate that the CBOE BXM has had considerably better risk-adjusted performance than the S&P 500. See Table 1 for corresponding Sharpe ratios.

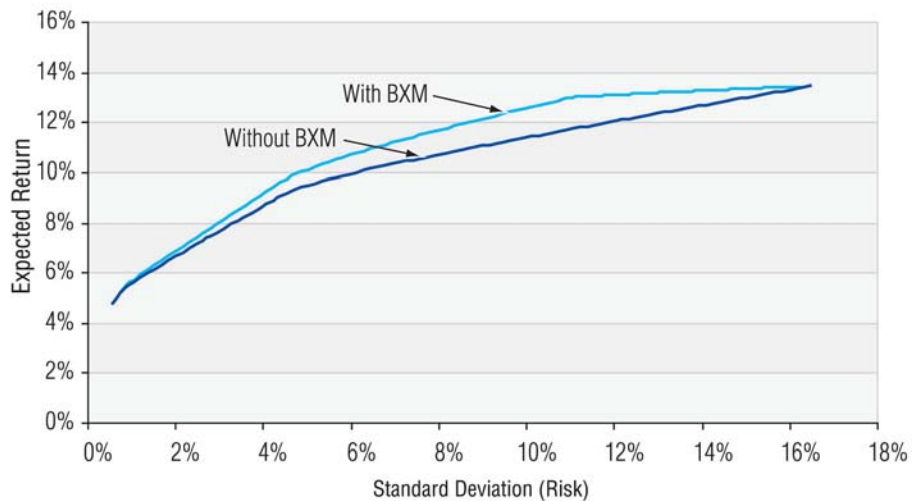


Figure 6: Expansion of the mean-variance efficient frontier when BXM is added to the asset mix. Monthly rebalance June 1988 to March 2004. Note that skew and kurtosis in assets is not taken into account in mean-variance analysis.

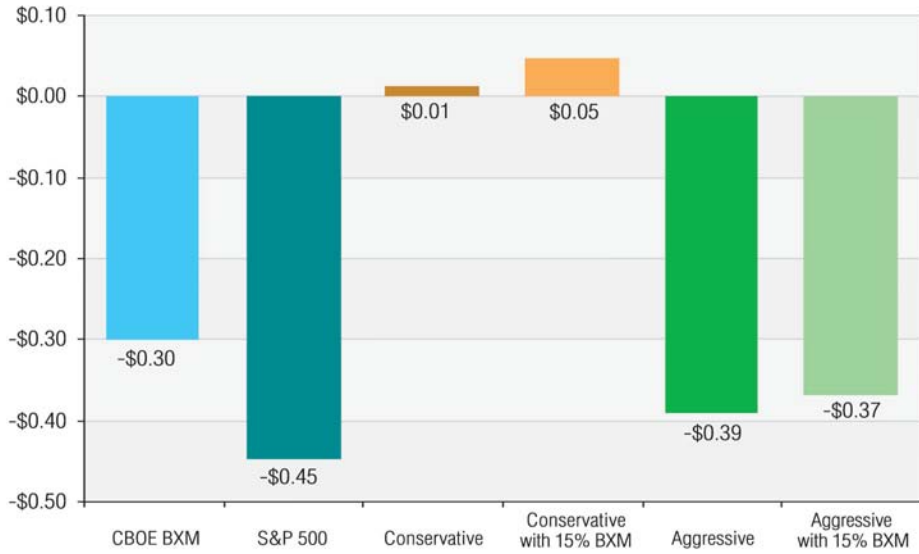


Figure 7: Cumulative change in portfolio value during the September 2000 to September 2002 drawdown. During the worst bear market since the great depression, the S&P 500 declined by 45%. The CBOE BXM declined by a more modest 30%. The conservative portfolio with 15% BXM increased in value by 5%.

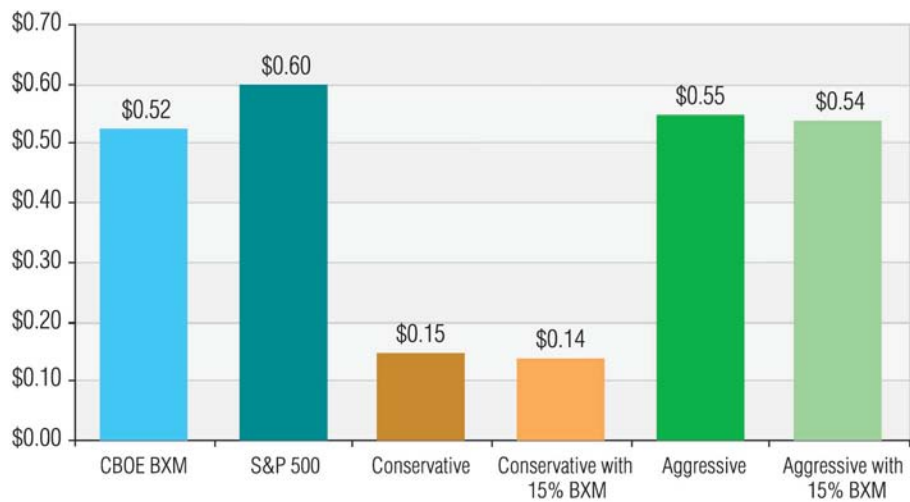
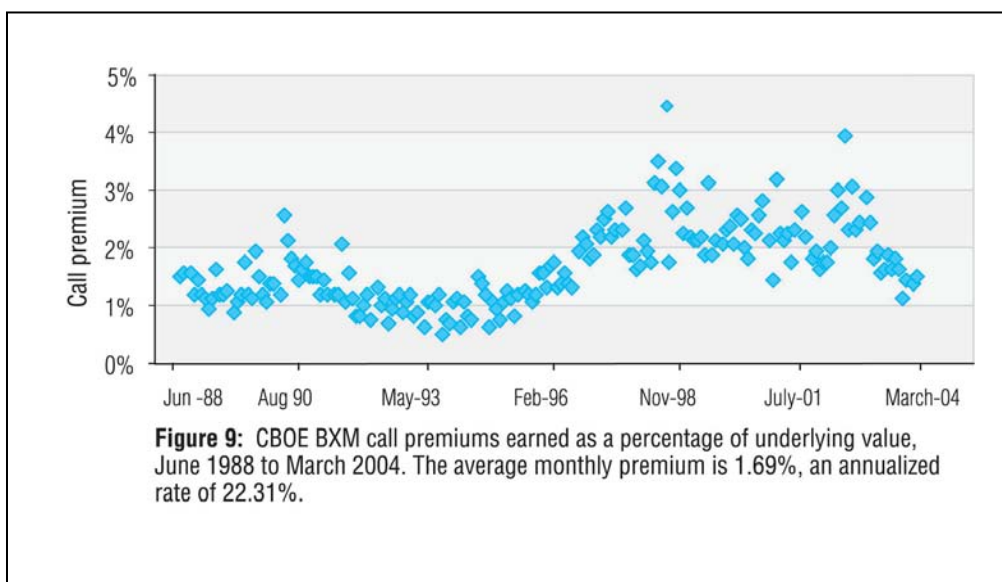


Figure 8: Cumulative change in portfolio value during the September 1998 to March 2000 run-up.



Statistic	CBOE BXM	S&P 500	Russell 2000	MSCI EAFE	LB Aggregate Bond Index	30 Day T-Bill
Monthly Arithmetic Mean	1.02%	1.05%	1.03%	0.52%	0.68%	0.38%
Monthly Compound Rate of Return	0.98%	0.96%	0.88%	0.40%	0.68%	0.38%
Monthly Standard Deviation	2.83%	4.22%	5.31%	4.91%	1.15%	0.17%
Excess Return	0.64%	0.67%	0.64%	0.13%	0.30%	---
Monthly Sharpe ratio	0.225	0.1592	0.1210	0.0273	0.266	---
Monthly Stutzer index	0.216	0.1577	0.1201	0.0273	0.263	---
Autocorrelation	-0.012	-0.046	0.125	-0.045	0.151	0.961
Skew	-1.249	-0.456	-0.530	-0.111	-0.361	-0.050
Excess Kurtosis	3.963	0.609	1.047	0.321	0.356	-0.462
Annualized Arithmetic Mean	12.93%	13.40%	13.04%	6.38%	8.53%	4.68%
Annualized Compound Rate of Return	12.39%	12.20%	11.14%	4.86%	8.45%	4.68%
Ann. Standard Deviation	10.99%	16.50%	20.73%	18.12%	4.29%	0.60%
Annualized Sharpe Ratio	0.752	0.529	0.402	0.093	0.907	---

TABLE 1: Summary statistics for BXM and selected asset classes, monthly data, June 1, 1988 to March 31, 2004. The Stutzer ratio is a measure of risk-adjusted returns controls for non-normality. It is equal to the Sharpe ratio for a normally distributed asset.

Statistic	CBOE BXM	CBOE BXM (Short hist.)	Rampart BXM	S&P 500	Russell 2000	MSCI EAFE	LB Aggregate Bond Index
Treynor Ratio (%)	14.10	25.02	26.41	8.72	9.02	2.32	79.00
Jensen's Alpha (%)	2.93	1.22	1.95	0.00	0.27	-4.26	3.23
TStatistic of Jensen's Alpha	2.41	0.27	0.42	0.00	0.09	-1.25	3.28
M-Squared (%)	17.20	22.77	23.72	13.40	11.28	6.14	19.46
Beta	0.59	0.64	0.62	1.00	0.92	0.72	0.05
Semi Std. Dev.	7.79	4.54	4.56	10.90	13.84	12.26	2.94
Sortino Ratio	1.56	6.43	6.44	1.15	0.85	0.33	2.81
Number of months	190	15	15	190	190	190	190

TABLE 1A: Supplementary annualized performance statistics. Rampart performance is reported, note there is only 15 months of history. CBOE BXM performance is reported for both entire history and Rampart subhistory.

Statistic	Rampart BXM	CBOE BXM	S&P 500	Russell 2000	MSCI EAFE	LB Aggregate Bond Index	30 Day T-Bill
Monthly Arithmetic Mean	1.34%	1.32%	1.85%	3.11%	2.59%	0.45%	0.08%
Monthly Compound Rate of Return	1.31%	1.30%	1.81%	3.03%	2.52%	0.44%	0.08%
Monthly Standard Deviation	2.25%	2.31%	3.07%	4.25%	3.80%	1.37%	0.01%
Excess Return	1.25%	1.24%	1.77%	3.03%	2.50%	0.37%	---
Monthly Sharpe ratio	0.556	0.535	0.577	0.712	0.658	0.271	---
Monthly Stutzer ratio	0.645	0.628	0.641	0.784	0.698	0.266	---
Autocorrelation	-0.19	-0.22	0.12	0.19	0.23	-0.06	0.46
Skew	1.11	1.21	0.58	0.32	0.16	-1.42	0.01
Excess Kurtosis	1.79	1.80	-0.21	-0.68	-0.07	3.92	-1.51
Annualized Arithmetic Mean	17.26%	17.05%	24.63%	44.43%	35.87%	5.57%	1.00%
Annualized Compound Rate of Return	16.95%	16.71%	24.02%	43.08%	34.84%	5.46%	0.99%
Ann. Standard Deviation	9.04%	9.27%	13.04%	20.72%	17.52%	4.97%	0.05%
Annualized Sharpe ratio	1.797	1.730	1.812	2.094	1.990	0.921	---

TABLE 2: Summary statistics for Rampart BXM, CBOE BXM and selected asset classes, monthly data, January 1, 2003 to March 31, 2004.

	Rampart BXM	CBOE BXM
Jan-03	-0.40%	-0.52%
Feb-03	-0.77%	-0.80%
Mar-03	-0.18%	0.03%
Apr-03	7.07%	7.18%
May-03	2.26%	1.70%
Jun-03	-0.66%	-0.43%
Jul-03	2.36%	2.47%
Aug-03	2.96%	2.87%
Sep-03	-1.86%	-1.87%
Oct-03	4.11%	4.63%
Nov-03	1.43%	1.21%
Dec-03	1.16%	1.72%
Jan-04	1.33%	0.44%
Feb-04	1.32%	1.33%
Mar-04	-0.09%	-0.14%

TABLE 3: Rampart BXM and CBOE BXM returns January 2003 to March 2004.

Asset Class	Conservative	Moderate	Aggressive
Large Cap Stocks	15%	35%	50%
Small Cap Stocks	0%	9%	17%
International Stocks	5%	16%	28%
Bonds	47%	30%	5%
Cash Equivalents	33%	10%	0%

TABLE 4: Standard Ibbotson Associates consulting portfolios.

Statistic	Conservative	Moderate	Aggressive
Monthly Mean	0.63%	0.79%	0.88%
Monthly Standard Deviation	1.06%	2.50%	3.86%
Excess Return	0.25%	0.40%	0.50%
Monthly Sharpe ratio	0.239	0.162	0.129
Monthly Stutzer index	0.237	0.160	0.127
Autocorrelation	-0.020	-0.004	0.018
Skew	-0.163	-0.545	-0.634
Excess Kurtosis	0.009	0.660	0.969
Annualized Mean	7.85%	9.87%	11.09%
Ann. Standard Deviation	3.92%	9.47%	14.79%
Annualized Sharpe ratio	0.818	0.547	0.432

TABLE 5: Standard Ibbotson Associates consulting portfolios. Monthly rebalance June 1988 to March 2004.

Statistic	Conservative	Moderate	Aggressive
Monthly Mean	0.63%	0.78%	0.87%
Monthly Standard Deviation	0.86%	2.26%	3.62%
Excess Return	0.24%	0.40%	0.49%
Monthly Sharpe ratio	0.289	0.177	0.136
Monthly Stutzer index	0.283	0.173	0.134
Autocorrelation	0.016	0.001	0.022
Skew	-0.386	-0.725	-0.753
Excess Kurtosis	0.162	1.130	1.327
Annualized Mean	7.78%	9.80%	11.02%
Ann. Standard Deviation	3.19%	8.56%	13.87%
Annualized Sharpe ratio	0.988	0.597	0.456

TABLE 6: Ibbotson Associates portfolios with 15% CBOE BXM. Monthly rebalance June 1988 to March 2004.

Statistic	Baseline	15% Covered Call	
		Rampart	BXM
Monthly Mean	0.65%	0.57%	0.57%
Monthly Standard Deviation	0.89%	0.75%	0.75%
Excess Return	0.56%	0.49%	0.48%
Monthly Sharpe ratio	0.631	0.647	0.650
Monthly Stutzer index	0.651	0.652	0.659
Autocorrelation	0.144	0.075	0.060
Skew	-0.088	-0.268	-0.241
Excess Kurtosis	0.146	0.733	0.765
Annualized Mean	8.05%	7.06%	7.03%
Ann. Standard Deviation	3.33%	2.78%	2.75%
Annualized Sharpe ratio	2.120	2.181	2.191

TABLE 7: Ibbotson Associates conservative portfolio and with 15% of CBOE or Rampart BXM substituted for large cap. Monthly rebalance January 2003 to March 2004.

Statistic	Baseline	15% Covered Call	
		Rampart	BXM
Monthly Mean	2.20%	2.12%	2.12%
Monthly Standard Deviation	3.15%	2.99%	2.99%
Excess Return	2.12%	2.04%	2.04%
Monthly Sharpe ratio	0.672	0.684	0.681
Monthly Stutzer index	0.741	0.760	0.757
Autocorrelation	0.234	0.209	0.200
Skew	0.438	0.501	0.501
Excess Kurtosis	-0.172	-0.021	-0.023
Annualized Mean	29.87%	28.70%	28.66%
Ann. Standard Deviation	13.91%	13.06%	13.10%
Annualized Sharpe ratio	2.075	2.119	2.111

TABLE 8: Ibbotson Associates aggressive portfolio and with 15% of CBOE or Rampart BXM substituted for large cap. Monthly rebalance January 2003 to March 2004.

	Monthly Arithmetic Mean (%)	Monthly Standard Deviation %
BXM TR	-2.54	3.09
S&P 500 TR	-4.86	2.75
Conservative	-.70	0.67
Conservative with 15% BXM	-.35	0.71
Aggressive	-4.37	3.00
Aggressive with 15% BXM	-4.02	3.00

TABLE 9: 41 Months over the period June 1988 to March 2004 when the S&P 500 TR was down 2% or more.

	Monthly Arithmetic Mean (%)	Monthly Standard Deviation (%)
BXM TR	2.95	1.69
S&P 500 TR	4.77	2.14
Conservative	1.46	0.68
Conservative with 15% BXM	1.18	0.59
Aggressive	3.96	2.14
Aggressive with 15% BXM	3.69	1.99

TABLE 10: 81 Months over the period June 1988 to March 2004 when the S&P 500 TR was up by 2% or more.

Annual Returns							
	Rampart TR	CBOE BXM TR	S&B 500 TR	Russell 2000 TR	MSCI EAFE TR	LB Aggregate Bond TR	US 30 Day T-Bill TR
1988*	--	8.13%	8.31%	5.43%	13.51%	5.24%	4.09%
1989	--	25.01%	31.49%	16.24%	10.80%	14.53%	8.38%
1990	--	3.99%	-3.17%	-19.52%	-23.20%	8.95%	7.84%
1991	--	24.40%	30.55%	46.03%	12.47%	16.00%	5.60%
1992	--	11.52%	7.67%	18.42%	-11.84%	7.40%	3.50%
1993	--	14.10%	9.99%	18.89%	32.94%	9.75%	2.90%
1994	--	4.49%	1.31%	-1.82%	8.06%	-2.92%	3.91%
1995	--	20.97%	37.43%	28.45%	11.55%	18.48%	5.60%
1996	--	15.50%	23.07%	16.51%	6.34%	3.61%	5.20%
1997	--	26.64%	33.37%	22.37%	2.05%	9.68%	5.25%
1998	--	18.95%	28.58%	-2.55%	20.34%	8.67%	4.85%
1999	--	21.17%	21.03%	21.25%	27.31%	-0.83%	4.69%
2000	--	7.40%	-9.10%	-3.02%	-13.95%	11.63%	5.88%
2001	--	-10.92%	-11.88%	2.49%	-21.21%	8.42%	3.82%
2002	--	-7.64%	-22.11%	-20.48%	-15.64%	10.27%	1.63%
2003	18.55%	19.37%	28.69%	47.25%	39.16%	4.11%	1.02%
2004*	2.58%	1.63%	1.70%	6.26%	4.41%	2.65%	0.22%

Table 11: *The 1988 returns are for June–December, and 2004 returns are for January–March. Annual returns June 1, 1988 to March 31, 2004 for all asset class indexes, CBOE BXM, and Rampart Investment Management BXM. Returns for 1988 and 2004 are not annualized.