Original Article

The anomalous behavior of the S&P covered call closed end fund

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ABSTRACT This article examines the anomalous behavior of the S&P Covered Call Closed End (BEP) Fund, which traded in 2007 at substantial premiums to its net asset value, which reached 23 per cent. The large premium is striking in light of the highly transparent and easy to replicate strategy of the fund, which involves rolling over one-month, at-the-money S&P 500 index covered calls. The article finds that the large premium was a result of BEP returns overreacting to positive S&P returns, adjusted for the deltas and gammas of the options that the fund was short. Another possible explanation for the emergence of the large premium was the near doubling of the VIX from very low and stable levels, which may have encouraged unsophisticated investors to buy the BEP fund at increasingly elevated premiums. The article then examines the anomaly from the perspective of the noise trader literature and finds that during the period of high premiums the volatility of BEP returns was not unusually high relative to the volatility of the underlying fundamentals, and that large premiums did not emerge at other covered call closed end funds. The evidence also indicates that short positions grew substantially during this period, which suggests that short covering may have been a factor behind the surge of the premium.

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INTRODUCTION

Equity index covered call strategies have enjoyed a recent resurgence in popularity, owing largely to evidence that these strategies have provided returns in line with those of the underlying index, but with substantially lower risk over the

last two decades (see Hill *et al.*,¹ Schneeweis and Spurgin,² Whaley,³ Feldman and Roy⁴ and Callan and Associates⁵). During the last few years, several closed end mutual funds that employ covered call strategies have been introduced. In addition, a variety of covered

call indexes have also been created by the Chicago Board Option Exchange (CBOE), including the BXM, which has become a benchmark for actively managed covered call strategies. The BXM index tracks the returns from rolling over on expiration days one-month, at-the-money S&P 500 index covered calls.

The S&P 500 Covered Call Closed End Fund (subsequently referred to by its ticker symbol – BEP) was introduced in April 2005. The stated strategy of the fund is to replicate BXM index returns.⁶ Because the CBOE provides specific information about the options used to construct the BXM index and because the BXM index level is broadcast to market participants every 15 seconds during trading days, the fund's strategy is both highly transparent and easy to replicate.⁷ These characteristics make the behavior of the BEP fund extremely anomalous in the first half of 2007 when after trading at small discounts to net asset value (NAV) for several months, the fund traded on a sustained basis at large premiums that reached as high as 23 per cent. Such large premiums typically occur mainly for closed end country funds when market participants become overly enthusiastic about the prospects for a particular country's equity market and when investing in that market either directly or through open end mutual funds is difficult, as demonstrated by Klibanoff *et al.*⁸ However, the BEP Fund is on the opposite end of the spectrum because the fund mimics the highly transparent and easy to replicate BXM index.⁹

This article models NAV and BEP fund returns in terms of the exposures of the Black–Scholes Greeks and then examines whether differences in how NAV and BEP returns responded to these exposures can explain the large premium that emerged in spring 2007.

The results indicate that the large premium can be attributed to an overreaction of BEP returns to positive S&P 500 index returns, adjusted for the deltas and gammas of the options that the fund was short. The article then explores other possible explanations for the large premiums and examines the anomaly from the perspective of the noise trader literature (see De Long *et al.*¹⁰).

The article proceeds as follows. The first section provides a brief discussion about covered call strategies as well as background information on the BEP fund. The second section models NAV and BEP returns and explores whether differences in responses to the exposures captured by the Greeks can explain the large premium that emerged in the first half of 2007. The third section explores other explanations for the large premium and examines the phenomenon from the perspective of the noise trader literature, and the final section summarizes the findings.

Background on the S&P 500 covered call fund

The BEP Fund began trading in April 2005 and at the end of 2007 had total net assets of US\$280 million and 17.5 million shares outstanding. The strategy of the fund is to replicate the BXM index by buying the S&P 500 index and rolling over on expiration dates short positions in one-month, at-the-money S&P 500 index calls.¹¹ Option premiums received by the fund and dividends on the S&P 500 stocks are distributed to share holders as dividends in June and December. These semi-annual dividends have been \$1 per share and on an annual basis have amounted to roughly 13 per cent of BEP share prices. Option

premiums received differ fundamentally from dividend income because the former represent compensation for the risk associated with the S&P 500 index being in the money at expiration by more than the value of option premiums received.¹² Figure 1 shows BEP share prices and the premium since the inception of the fund in April 2005 through the end of March 2008, with the large downward spikes representing distributions. The figure shows that BEP shares began trading at a 5 per cent premium and within a year went to a 10 per cent discount, as BEP shares lost 7 per cent on a dividend-adjusted basis, which is fairly typical as shown by Dimson and Minio-Kozerski¹³ and Weiss.¹⁴ During the second year, the 10 per cent discount surged to a premium that reached 23 per cent and BEP shares returned 36-1/2 per cent. In the third year through the end of March, the large premium moved to a discount of approximately 5 per cent and BEP shares lost approximately 16 per cent. Overall, the figure shows that the premiums that emerged in the

second year of trading were both outsized and sustained, and underscores the substantial role played by the premium in determining BEP fund returns.¹⁵ The next section of the article provides background on covered call strategies.

Background on S&P 500 index covered call strategies

Covered call strategies are attractive if options are overpriced because option premiums received are worth more than the present value of the expected foregone gains when the underlying instrument is above the strike at expiration. At-the-money covered call strategies cut deltas roughly in half. The negative gammas of covered call positions cause both the positive deltas to fall toward zero if the S&P increases on a sustained basis during option cycles because further gains are limited, and to rise toward one when the S&P decreases on a sustained basis as the prices of the options sold move toward their

Figure 1: The S&P covered call closed end fund price (thick line) and the per cent premium (thin line) from April 2005 to March 2008.

intrinsic value of zero.¹⁶ As a result, the sensitivity of NAV and presumably BEP returns to S&P returns should fluctuate over expiration cycles. Covered call positions also benefit from implied volatility decreases and from time decay. To the extent that the above factors explain NAV returns, they tautologically explain either BEP returns or BEP premium changes or some combination of the two.

FACTORS DRIVING NAV AND BEP RETURNS

This section examines how well NAV returns can be modeled by the exposures to the Greeks and then examines how BEP returns respond to the same factors. To the extent that NAV and BEP returns have different sensitivities to particular exposures, it may be possible to identify specific market factors responsible for the large premium. This article calculates the Greeks from the Black–Scholes model using the adjustment suggested by French¹⁷ with time expressed in business days when it is multiplied by volatility and time expressed in calendar days when it is multiplied by interest rates. In addition, the S&P 500 index is adjusted for actual dividends and for the 15-min interval between the settlement of the S&P 500 cash index at 16:00 EST and S&P 500 index options at 16:15 EST.¹⁸ The impact from delta (DELTARETS) of a change in the underlying S&P 500 cash index (SPX) on NAV returns is given by

$$\text{DELTARETS} = \frac{[1 - \Delta_{t-1}] \times [\text{SPX}_t - \text{SPX}_{t-1}]}{\text{SPX}_{t-1} - C_{t-1}} \quad (1)$$

The numerator is the dollar returns from delta, which is equal to one minus the previous day

closing delta of the calls sold by the BEP fund multiplied by the change of the S&P index. These dollar returns are scaled by the previous closing values of the covered call position – the previous closing value of the SPX index minus the previous closing value of the call options that the BEP fund is short – to obtain returns owing to the exposure to delta.

The above equation accurately reflects returns on covered call positions for small S&P price changes but overstates positive returns and understates negative returns when absolute S&P price changes are large. The returns from gamma (GAMMARETS) are given in equation 2) and are equal to dollar profits from gamma, scaled by the previous closing values of the covered call position. The numerator is equal to -0.5 times the previous day closing gamma of the options that the BEP fund is short multiplied by the squared S&P index price change. The returns from gamma are non-positive, as the curvature of the relationship between call option prices and changes of the underlying instrument price works against the option seller.

$$\text{GAMMARETS} = \frac{-0.5 \times \Gamma_{t-1} \times (\text{SPX}_t - \text{SPX}_{t-1})^2}{\text{SPX}_{t-1} - C_{t-1}} \quad (2)$$

Equations (1) and (2) are added to obtain what will be referred to as (delta- and gamma-) adjusted returns (ADJRETS).

$$\begin{aligned} \text{ADJRETS} &= \frac{[(1 - \Delta_{t-1}) \times (\text{SPX}_t - \text{SPX}_{t-1})] - 0.5 \times \Gamma_{t-1} \times (\text{SPX}_t - \text{SPX}_{t-1})^2}{\text{SPX}_{t-1} - C_{t-1}} \end{aligned} \quad (3)$$

The returns from vega (VEGARETS) are as follows:

$$\text{VEGARETS} = \frac{v_{t-1} \times (\sigma_t - \sigma_{t-1})}{\text{SPX}_{t-1} - C_{t-1}} \quad (4)$$

where the previous day closing vega of the options sold by the BEP fund is multiplied by the change in implied volatility of those options to obtain the dollar impact on the covered call position, which is scaled by the previous day closing value of the covered call position. An increase in VEGARETS should lower the value of covered call positions because implied volatility increases raise the value of options that have been sold.

Finally, the returns from theta (THETARETS) are given by

$$\text{THETARETS} = \frac{\tau_{t-1}}{\text{SPX}_{t-1} - C_{t-1}} \quad (5)$$

where the theta of the options sold at the previous close is scaled by the previous closing value of the covered call position to obtain the returns on the covered call position from time decay.

Factors driving NAV returns

The first set of models examines how well dividend-adjusted NAV returns can be explained by the Greeks. The specification is as follows

$$\begin{aligned} \text{NAVRETS}_t = & \alpha_0 + \alpha_1 \times \text{ADJRETS}_t^+ \\ & + \alpha_2 \times \text{ADJRETS}_t^- \\ & + \alpha_3 \times \text{VEGARETS}_t \\ & + \alpha_4 \times \text{THETARETS}_t + u_t \quad (6) \end{aligned}$$

where daily NAV returns are regressed on a constant and on positive and negative delta- and gamma-adjusted S&P returns and on vega and theta returns. If NAV returns move in line with the Greeks, the coefficients on delta- and gamma-adjusted S&P returns should be significantly positive and not significantly different from one, and the coefficients on vega and theta returns should be significantly negative and not significantly different from minus one.

Standard errors are estimated using the Newey–West method for heteroscedasticity and for autocorrelation up to six lags owing to a few spikes in the autocorrelation function of the residuals. The equation is estimated for the entire sample period from 13 April 2005 through 28 March 2008, the Pre-Anomaly Period from 13 April 2005 through 23 January 2007, the Anomaly Period from 24 January 2007 through 22 May 2007 when the premium surged from 5 to 23 per cent with little retracement and then fell below 10 per cent, and the Post-Anomaly Period from 23 May 2007 through 28 March 2008.

The results in Table 1 indicate that most of the variation of daily NAV returns is explained by the Greeks, with an adjusted R^2 of 0.93 for the whole sample period and with the vast majority of the Greeks entering with highly statistically significant coefficients of the expected sign. Positive and negative adjusted S&P returns enter with highly significant coefficients that are close to one and thus do not reflect any asymmetric or disproportionate impact on NAVs. Vega returns enter with significantly negative coefficients in all but the Post-Anomaly Period, while theta returns enter with significantly negative coefficients in each of the sub-periods. The response of NAV returns to vega returns is less than expected based on the Black–Scholes model, while the response of NAV returns to theta returns is greater than expected.¹⁹

Factors driving BEP fund returns

The previous results indicate that the vast majority of the variation of NAV returns is explained by the exposures to the Greeks. The extent to which the Greeks also explain BEP

Table 1: The factors driving the S&P 500 Covered Call Fund daily NAV returns from 13 April 2005 through 28 March 2008

$$\text{NAVRETS}_t = \alpha_0 + \alpha_1 \times \text{ADJRETS}_t^+ + \alpha_2 \times \text{ADJRETS}_t^- + \alpha_3 \times \text{VEGARETS}_t + \alpha_4 \times \text{THETARETS}_t + u_t$$

	<i>Whole period</i>	<i>Pre-Anomaly period</i>	<i>Anomaly period</i>	<i>Post-Anomaly period</i>
	4/13/05–3/28/08	4/13/05–1/23/07	1/24/07–5/22/07	5/23/07–3/28/08
Constant	−0.0003** (0.0001)	−0.0004* (0.0002)	−0.0009* (0.0004)	−0.0002 (0.0002)
ADJRETS _t ⁺	1.0644** (0.02216)	1.0757** (0.0237)	1.0904** (0.0447)	1.0603** (0.0323)
ADJRETS _t [−]	1.0346** (0.0187)	1.0243** (0.0484)	0.9159** (0.0353)	1.0497** (0.0259)
VEGARETS _t	−0.3066* (0.1484)	−0.2883* (0.1422)	−0.7000** (0.1875)	−0.3014 (0.2742)
THETARETS _t	−1.9673** (0.2329)	−2.4150** (0.5208)	−3.6389** (0.9498)	−1.8632** (0.2861)
RBAR ²	0.9305	0.8633	0.9591	0.9551
NOBS	743	447	82	214

Daily NAV returns are regressed on a constant and contemporaneous variables for delta- and gamma-adjusted positive and negative S&P returns (ADJRETS), vega returns (VEGARETS) and theta returns (THETARETS). The variables are standardized so that the coefficients on the delta- and gamma-adjusted returns should be one and the coefficients on vega and theta returns should be minus one. The equations are estimated with OLS and with standard errors corrected for heteroscedasticity and autocorrelation through six lags with the Newey–West correction. Two and one asterisks denote statistical significance at the 1 and 5 per cent levels, respectively.

share returns is important because if the Greeks have different effects on BEP and NAV returns, it may be possible to identify the source of the large BEP premiums. The next step is to determine how BEP returns respond to the specific exposures that drive NAVs by estimating

$$\begin{aligned} \text{BEPRETS}_t = & \beta_0 + \beta_1 \times \text{PREM}_{t-1} \\ & + \beta_2 \times \text{ADJRETS}_t^+ \\ & + \beta_3 \times \text{ADJRETS}_t^- \\ & + \beta_4 \times \text{VEGARETS}_t \\ & + \beta_5 \times \text{THETARETS}_t + \varepsilon_t \end{aligned} \quad (7)$$

where daily BEP returns are regressed on a constant, the lagged premium, separate variables

for contemporaneous positive and negative adjusted S&P returns, vega returns and theta returns, as defined earlier. The lagged premium (in per cent) is included to reflect a possible tendency for premiums or discounts to dissipate.²⁰ If BEP returns respond to the factors driving NAV returns, the coefficients on adjusted positive and negative S&P returns again should be significantly positive and not different from one, and the coefficients on vega and theta returns should be significantly negative and not different from minus one.

The results in Table 2 demonstrate that BEP returns respond sluggishly to both adjusted positive and negative S&P returns during the

Table 2: The factors driving S&P 500 Covered Call (BEP) share daily returns from 13 April 2005 through 28 March 2008
$$\text{BEPRET}_t = \beta_0 + \beta_1 \times \text{PREM}_{t-1} + \beta_2 \times \text{ADJRETS}_t^+ + \beta_3 \times \text{ADJRETS}_t^- + \beta_4 \times \text{VEGARETS}_t + \beta_5 \times \text{THETARETS}_t + \varepsilon_t,$$

	<i>Whole period</i>	<i>Pre-anomaly period</i>	<i>Anomaly period</i>	<i>Post-Anomaly period</i>
	(4/13/05–3/28/08)	(4/13/05–1/23/07)	(1/24/07–5/22/07)	(5/23/07–3/28/08)
Constant	0.00071(0.0011)	−0.0011(0.0014)	0.0045(0.0044)	0.00250(0.0032)
PREM _{t−1}	−0.0132** (0.0054)	−0.0158(0.0084)	−0.0503* (0.0236)	−0.0358* (0.01430)
ADJRETS _t ⁺	0.8693** (0.1471)	0.4598** (0.1543)	2.3280** (0.3804)	0.9436** (0.2096)
ADJRETS _t [−]	0.9083** (0.0937)	0.4833** (0.1509)	0.8852** (0.2271)	1.0132** (0.1465)
VEGARETS _t	0.0848(0.6064)	0.5740(0.6705)	−2.9433(1.6872)	−0.0223(0.9862)
THETARETS _t	0.4089(2.909)	−4.2803(3.8660)	−5.7005(9.3278)	3.3734(5.336)
RBAR ²	0.208	0.036	0.448	0.320
Q(6) (sign. level)	7.01(0.319)	7.84(0.250)	10.52(0.104)	8.35(0.213)
NOBS	743	447	82	214

Daily BEP returns are regressed on a constant, the lagged premium, contemporaneous variables for delta- and gamma-adjusted positive and negative S&P returns (ADJRETS), vega returns (VEGARETS) and theta returns (THETARETS). The variables are standardized so that the coefficients on the delta- and gamma-adjusted returns should be one and the vega and theta returns should be minus one. The equations are estimated with OLS and with standard errors corrected for heteroscedasticity using White's method. Two and one asterisks denote statistical significance at the 1 and 5 per cent levels, respectively.

Pre-Anomaly Period. The coefficient estimates indicate that 1 per cent increases (decreases) in adjusted S&P returns lead to 1/2 per cent increases (decreases) in BEP returns that are statistically significant but also significantly less than one. These results are consistent with BEP returns underreacting to both positive and negative S&P returns during the Pre-Anomaly Period. The estimates also show that BEP returns do not respond to either vega or theta exposures in the Pre-Anomaly Period nor in any of the other sub-periods, and the low adjusted

R^2 of 0.04 for the Pre-Anomaly Period shows that very little of the variation of BEP returns is explained by the Greeks.

BEP returns react much more strongly to the Greeks during the Anomaly Period, and the model now explains almost half of the variation of daily BEP returns. The coefficient estimates indicate that a 1 per cent increase in positive adjusted S&P returns is associated with a 2.3 per cent increase in BEP returns that is both statistically significant and significantly greater than one. The reaction of BEP returns to

negative adjusted S&P returns is consistent with a statistically significant commensurate BEP return decline.

The results for the Post-Anomaly Period indicate a statistically significant, one-to-one relationship between both positive and negative adjusted S&P returns and BEP returns. Overall, the results suggest that the large premium that emerged during the Anomaly Period is a result of the overreaction of BEP returns to positive adjusted S&P returns. The sequential pattern across the three sub-periods from underreaction to overreaction to proportional reaction with respect to delta- and gamma-adjusted S&P returns may reflect an ongoing learning process.²¹

Factors driving the premium

The next step is to obtain more direct estimates of the impact of the Greeks on BEP share premiums across sub-periods by estimating a model of the daily change of the premium as a function of a constant, the lagged premium, the contemporaneous delta- and gamma-adjusted positive and negative S&P returns, vega returns and theta returns, as defined earlier.

$$\begin{aligned} \Delta \text{PREM}_t = & \beta_0 + \beta_1 \times \text{PREM}_{t-1} + \beta_2 \times \text{ADJRETS}_t^+ \\ & + \beta_3 \times \text{ADJRETS}_t^- + \beta_4 \times \text{VEGARETS}_t \\ & + \beta_5 \times \text{THETARETS}_t + \varepsilon_t \end{aligned} \quad (8)$$

If the coefficients on S&P-adjusted returns are significantly positive (negative), BEP returns respond more (less) than NAV returns and hence overreact (underreact) to adjusted S&P returns. A positive (negative) coefficient on vega returns would indicate that BEP returns respond less (more) than NAV returns to implied volatility changes in light of earlier evidence that shows that NAV returns fall when vega returns rise.

Finally, if the coefficient on theta returns is positive (negative), time decay causes BEP share prices to fall by more (less) than NAV prices.

The results in Table 3 indicate that the underreaction of BEP returns to NAV returns during the Pre-Anomaly Period is a result of an underreaction to both positive and negative adjusted S&P returns as the coefficients on both terms are significantly negative, with the coefficient estimates indicating that positive and negative adjusted S&P returns lead to declines and increases in premiums that are approximately half the size of the adjusted S&P returns, respectively. During the Anomaly Period, positive adjusted S&P returns lead to higher premiums, with the coefficient estimate indicating that 1 per cent positive adjusted S&P returns lead to 1.4 per cent premium increases, while negative adjusted S&P returns have no impact on premiums. In the Post-Anomaly Period, neither positive nor negative adjusted returns lead to premium changes and neither vega nor theta returns significantly affect premiums in any of the sub-periods.

Overall, the results demonstrate that BEP share prices responded sluggishly to adjusted S&P returns during the first 1-3/4 years of trading and then overreacted to positive adjusted S&P returns during the Anomaly Period, when the premium went from 5 to 23 per cent. The next section takes a more in-depth look at the Anomaly Period.

An in-depth examination of the Anomaly Period

Although the evidence in the previous section indicates that the premium that emerged during the Anomaly Period can be attributed to an overreaction of BEP shares to delta- and

Table 3: Tests of whether daily S&P 500 covered call (BEP) premium changes are driven by the Greek exposures from April 2005 through March 2008
$$\Delta \text{PREM}_t = \beta_0 + \beta_1 \times \text{PREM}_{t-1} + \beta_2 \times \text{ADJRETS}_t^+ + \beta_3 \times \text{ADJRETS}_t^- + \beta_4 \times \text{VEGARETS}_t + \beta_5 \times \text{THETARETS}_t + \varepsilon_t$$

	<i>Whole period</i>	<i>Pre-Anomaly period</i>	<i>Anomaly period</i>	<i>Post-Anomaly period</i>
	(4/13/05–3/28/08)	(4/13/05–1/23/07)	(1/24/07–5/22/07)	(5/23/07–3/28/08)
Constant	0.0010(0.0011)	−0.0006(0.0014)	0.0057(0.0051)	0.0028(0.0032)
PREM _{t−1}	−0.0135** (0.0059)	−0.0168* (0.0085)	−0.0545* (0.0278)	−0.0360* (0.0146)
ADJRETS _t ⁺	−0.2029(0.1469)	−0.6216** (0.1568)	1.423** (0.4488)	−0.1412(0.2039)
ADJRETS _t [−]	−0.1214(0.0960)	−0.5247** (0.1570)	−0.0396 (0.2538)	−0.0377(0.1454)
VEGARETS _t	0.3658(0.6407)	0.9261(0.6661)	−2.488(1.950)	0.2017(1.050)
THETARETS _t	2.418(2.844)	−1.778(3.809)	−2.702(10.751)	5.292(5.291)
RBAR ²	0.011	0.072	0.109	0.004
Q(6) (sign. level)	6.83(0.336)	7.65(0.265)	10.74(0.100)	9.09(0.168)
NOBS	743	447	82	214

Daily premium changes are regressed on a constant and contemporaneous variables for delta- and gamma-adjusted positive and negative S&P returns, vega returns and theta returns. The equations are estimated with OLS and with standard errors corrected for heteroscedasticity using White's method. Two and one asterisks denote statistical significance at the 1 and 5 per cent levels, respectively.

gamma-adjusted positive S&P returns, it does not explain why the overreaction occurred. Figures 2a–2c provide an in-depth look at the factors that may have contributed to the large premium during the Anomaly Period. These factors include the S&P 500 index, the S&P 500 Volatility Index (VIX) and the deltas of the options that the BEP fund was short.²² The figures do not show an obvious catalyst for the initial increase in the premium from 5 to 10 per cent during February 2007, as S&P prices were flat (Figure 2a) and the VIX (Figure 2b) remained at the low levels between 10 and 11 per cent that had persisted for several months.

On 27 February, the S&P index fell from 1450 to 1400, and the VIX spiked to 18 per cent and remained elevated for a few weeks. The premium increased over the next few weeks despite the minimal protection provided by the 1455 strike call that the fund was short, which had moved well out of the money and consequently had a delta close to zero (Figure 2c). One possibility is that the spike of the VIX and the general rise in implied volatilities encouraged investors to adopt covered call strategies and caused BEP investors to bid up further the price of BEP shares relative to their NAVs.²³ As the S&P index rebounded in the

Figure 2: (a) The BEP fund premium (heavy line) and level of the S&P 500 index level during the Anomaly Period; (b) The BEP fund premium (heavy line) and VIX during the Anomaly Period; (c) The BEP fund premium (heavy line and left axis) and delta of the option that the BEP fund is short during the Anomaly Period.

second half of March from 1400 to 1430, the premium rose from roughly 15 per cent to its peak of 23 per cent as BEP share prices strongly overreacted to positive delta- and gamma-adjusted S&P returns, and as the 0.8 delta of

the 1395 strike call that the BEP fund was short substantially limited potential further NAV returns. The decline of the premium from its high of 23 per cent at the end of March to 10 per cent at the beginning of May occurred

while the S&P 500 index rallied from 1420 to around 1530 and the VIX dropped from around 15 to 13 per cent. Thus, the premium rose and fell more with the VIX than with the S&P 500 index. This is consistent with the possibility that the sharp VIX increase made covered call strategies more appealing and encouraged unsophisticated investors to bid up the premiums of the BEP fund. The next section examines the large increase in the premium from a noise trader perspective.

A noise trader perspective on the Anomaly Period

In light of the extremely transparent and easy to replicate strategy of the fund, the large run-up of the premium is evidence of noise trader activity. Lee *et al*²⁴ argue that swings in the sentiment of small investors drive closed end fund discounts, which should cause closed end fund discounts to move together. An interesting issue is whether the large premium that emerged in the BEP fund was part of a general increase in premiums that small and unsophisticated investors were willing to pay for covered call closed end funds or was specific to the BEP fund.

Figure 3 shows the BEP fund premium over the period from September 2005 through March 2008, as well as the average premium of 11 other covered call closed end funds.²⁵ The figure shows that the average behavior of the other funds was in line with the BEP fund from mid- to late 2006, as both went from 5 per cent discounts to parity. However, as the BEP fund subsequently moved to a 23 per cent premium, the average premiums of the other covered call closed end funds rose to only 4 per cent, with the highest rising to only 10 per cent. Thus, the large increase in the BEP fund premium was largely a fund-specific event rather than a general increased willingness to pay large premiums for covered call closed end funds.²⁶

In the noise trader model of De Long *et al*¹⁰ noise traders cause transitory market inefficiencies because arbitrage is risky. This risk is a result of the difficulty of constructing perfectly hedged arbitrage positions and of the possibility that noise traders irrationally push mispriced securities further away from fundamental values (see Shleifer and Vishny²⁷). Since traders who short the BEP fund can easily and effectively hedge their NAV exposure, the

Figure 3: Premiums of the BEP fund (heavy line) and the average premium of 11 other covered call closed end funds (medium line).

major risk that they face is noise trader risk.²⁸ A hallmark of the presence of noise traders in the current context would be elevated BEP share price volatility relative to the volatility of the fundamentals as reflected by NAV volatility. Although the NAV is reported only at the close, the intraday volatility of the fundamentals can be determined from the BXM index because the BEP fund follows the strategy of the BXM, which is reported to market participants during the trading day. The Garman–Klass²⁹ daily annualized standard deviation of BEP and BXM logarithmic returns is calculated based on the open, high, low and close of BEP share prices and the BXM index as

$$\sigma = \{[(\ln O_t/C_{t-1})^2 + 0.5 \times (\ln H_t/L_t)^2 - 0.39 \times (\ln C_t/O_t)^2]^{0.5}\} \times \sqrt{252} \quad (9)$$

Figure 4 shows the BEP premium and the differences between the 5-day moving averages of the BEP and the BXM return annualized volatility estimates from when the CBOE began broadcasting intraday data for the BXM index from September 2006 through March 2008. The figure shows that while BEP return volatility consistently outpaced BXM return volatility over the sample period, the volatility of BEP shares relative to the volatility of the BXM index was not noticeably greater during the Anomaly Period.

Other noise trader models such as that of Abreu and Brunnermeier³⁰ emphasize that mispricings can persist owing to the need for a critical mass of arbitrageurs to counteract the effect of noise traders. A related question is whether the large BEP premium was driven by

Figure 4: The BEP premium (heavy line and left scale) and the spread between the 5-day moving averages of the BEP and BXM index annualized return volatilities using the Garman–Klass Method (thin line and right scale) from September 2006 to March 2008.

Figure 5: BEP premium (left scale) and short interest (right scale).

arbitrageurs whose timing was off and who were forced to cover short BEP share positions as premiums continued to rise and losses mounted. Figure 5 shows the premium of the BEP fund and the level of short interest over the life of the fund. Short interest was approximately 80 000 shares in the months following the IPO, as the BEP fund initially traded at a premium and short sellers presumably anticipated the typical move toward a discount in the year after a closed end fund IPO. Short interest was at negligible levels over much of 2006, as the BEP fund traded at a discount. It then rose at the end of 2006, and when the premium increased from 5 to 15 per cent from the end of January through mid-March of 2007, short interest picked up from 100 000 shares to 240 000 shares, with the latter representing approximately two times average daily trading volume.³¹ Thus, a significant build in short positions occurred during the run-up of the premium. This could have increased the premium further, as traders who shorted BEP shares were forced to cover losing bets by buying back BEP shares. In this case, the large short position increase could have reflected a sequence of arbitrageurs setting up short positions and being forced to buy back shares because of their poor timing.

Short positions peaked at 28 000 shares after the premium crested at 23 per cent and remained at elevated levels as the premium deflated.

CONCLUSIONS

This article examines the behavior of the S&P 500 Covered Call Closed End Fund (BEP), which traded for a few months in 2007 at substantial premiums to its NAV, which reached 23 per cent. These large premiums are anomalous in light of the highly transparent and easy to replicate strategy of the fund, which involves rolling over one-month, at-the-money S&P 500 index covered calls. This article estimates the response of BEP and NAV daily returns to the exposures of the Black–Scholes Greeks and finds that the large run-up of the premium can be attributed to BEP returns overreacting to positive S&P 500 returns, adjusted for the deltas and gammas of the options that the fund was short.

The article then provides evidence consistent with the possibility that the large premium was driven by a near doubling of the VIX from very low levels, which may have led unsophisticated market participants to bid up BEP share prices

without regard to the underlying NAVs. However, the large premium was isolated to the fund, as the average premiums of 11 other covered call closed end funds rose only to modest premiums. Although the volatility of BEP returns surpassed the volatility of the fundamentals over the entire sample period, this measure of noise trader activity did not increase during the period when the large premium emerged. Finally, the article examines the pattern of short interest and finds a substantial build in short positions as the premium rose, which suggests that a possible contributor to the run-up of the premium was the poor timing of arbitrageurs who later were forced to cover short positions as losses mounted.

Overall, while the study econometrically identifies the source of the anomaly – an overreaction to positive delta- and gamma-adjusted S&P 500 returns – identifying the underlying reasons for the overreaction is far more challenging. The most likely explanations are the large jump of the VIX and short covering under duress by arbitrageurs who rightly saw the large premium as unsustainable over the long run but who underestimated the ability of BEP shares to become even more overpriced in the short run.

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- 1 Hill, J., Balasubramanian, V., Gregory, K. and Tierens, I. (2006) Finding alpha via covered call writing. *Financial Analysts Journal* 62(5): 279–346, These authors find that from January 1990 through November 2005, at-the-money S&P 500 index covered call strategies outperformed the underlying index by 233 basis points with an annualized standard deviation of 8.5 per cent versus an annualized standard deviation of 14.15 per cent for the S&P 500 index.
- 2 Schneeweis, T. and Spurgin, R. (2001) The benefits of index option-based strategies for institutional portfolios. *The Journal of Alternative Investments* 3(4): 44–52.
- 3 Whaley, R. (2002) Return and risk of CBOE Buy-Write Monthly Index. *Journal of Derivatives* 10(2): 35–42.
- 4 Feldman, B. and Roy, D. (2005) Passive options-based investment strategies: The case of the CBOE S&P 500 Buy-Write Index. *The Journal of Investing* 14(2): 72–89.
- 5 Callan and Associates. (2006) An historical evaluation of the CBOE S&P 500 BuyWrite Index Strategy, http://www.cboe.com/micro/bxm/Callan_CBOE.pdf.
- 6 Unreported regressions of BEP net asset value daily returns on daily BXM returns result in highly significant slope coefficients that are not different from one and R^2 s of around 0.95 across a variety of subsamples.
- 7 Investors can achieve the same exposure by buying an exchange-traded fund based on the S&P 500, such as the SPY, and rolling over short positions in one-month, at-the-money SPY calls. Alternatively, because covered call positions are equivalent to uncovered short put positions, investors can replicate the strategy of the BEP fund by rolling over uncovered one-month, at-the-money S&P 500 index put short positions.
- 8 Klibanoff, P., Lamont, O. and Wizman, T. (1988) Investor reaction to salient news in closed-end country funds. *Journal of Finance* 53(2): 673–699, Notable examples are the Germany fund, which traded at a 100 per cent premium after the fall of the Berlin Wall, and the Turkish Investment Fund, which traded at a 100 per cent premium in April 1994.
- 9 It would not necessarily be irrational for the BEP fund to trade at small premiums. The BEP fund charges annual management fees of 0.9 per cent and incurs expense ratios of about 1 per cent, which could be lower than the cost incurred by unsophisticated investors who roll over S&P 500 index option short positions every month.
- 10 De Long, B., Shleifer, A., Summers, L. and Waldmann, R. (1990) Noise trader risk in financial markets. *Journal of Political Economy* 98(4): 703–738.
- 11 S&P 500 index options are European options that are cash settled based on the opening level of the S&P

- 500 cash index when options expire on the third Friday of each month.
- 12 Although some confusion could exist concerning the fundamental difference between income from dividends and income from option premiums, the author was unable to find evidence in the press or in promotional materials reflecting such confusion. Nevertheless, Morningstar and Yahoo.com recently listed the dividend yield on the fund at 13.2 per cent.
 - 13 Dimson, E. and Marsh, P. (1999) Closed-end funds: A survey. *Financial Markets, Institutions & Instruments* 9(3): 1–41. These authors report in a survey that US closed end fund shares are issued at premiums of up to 10 per cent, while Weis¹⁴ finds that US closed end funds within 24 weeks of issuance trade at average discounts of 10 per cent.
 - 14 Weiss, K. (1989) The post-offering price performance of closed-end funds. *Financial Management* 18(3): 57–67.
 - 15 Daily trading volume of BEP shares (not shown) increased in the first half of 2007 when the large premiums emerged, averaging 122 000, compared to 60 000 shares from April 2005 through the end of 2006 and 70 000 shares from mid-2007 through March 2008.
 - 16 This statement is made largely for expositional ease as S&P index options are cash settled and thus the underlying portfolio of stocks is not disturbed when options expire in the money.
 - 17 French, K. (1984) The weekend effect on the distribution of stock prices: Implications for option pricing. *Journal of Financial Economics* 13(4): 547–559.
 - 18 The S&P cash index is adjusted by calculating its fair value based on the closing front S&P futures price at 16:15, future dividends and the relevant short-term deposit rate.
 - 19 These divergences may reflect the effect of cross-derivatives, possible model misspecification and imprecise adjustment for the 15-min interval between the settlement of the S&P 500 cash index and index options.
 - 20 A variety of specifications were examined such as allowing asymmetric responses to premiums and discounts and allowing BEP returns to respond to premium changes, but these specifications did not lead to interesting results and are not reported.
 - 21 The terms overreaction and underreaction are used for expositional ease to discuss the proportionalities of reaction and do not necessarily imply irrationality *per se*. For example, an implication of the noise trader model of De Long *et al*¹⁰ is that market events that indicate greater noise trader uncertainty justify larger closed end fund discounts because rational market participants require compensation for this incremental risk.
 - 22 The models examined in the previous section were also estimated with the change of the VIX representing the impact of changes in volatility assumptions. The rationale was to allow for the possibility that the unsophisticated market participants who bid up BEP premiums were looking at general measures of implied volatility rather than considering the impact of a change in the implied volatility assumption of the specific options that the fund was short. Although the change of the VIX did not enter the models significantly, this does not rule out the possibility that the substantial jump of the VIX was the source of the large premium that emerged.
 - 23 While the BEP fund fell approximately 4 per cent on 27 February, it was trading at higher levels than prior to the large decline within seven trading days.
 - 24 Lee, C., Shleifer, A. and Thaler, R. (1991) Investor sentiment and the closed-end fund puzzle. *Journal of Finance* 46(1): 76–110.
 - 25 These funds include the Enhanced Covered Call Fund (EEO), the Eaton Vance Tax Managed Global Buy-Write Opportunity Fund (ETW), the Eaton Vance Tax Managed Buy Write Fund (ETV), the Eaton Vance Tax Managed Buy Write Income Fund (ETB), the Madison Strategic Sector Premium Fund (MSP), the Nuveen Index Options and Equities Fund (JSN), the NFJ Dividend, Interest and Premium Strategy Fund (NFJ), the Nuveen Equity Premium Fund (JPZ), the Madison Claymore Covered Call Fund (MCN), the First Trust Fiduciary Asset Management Covered Call Fund (FFA) and the Dow 30 Premium and Dividend Income Fund (DPD).
 - 26 Another possibility is that dividend capture strategies could cause transitory premiums given the large distributions of the BEP fund. This possibility is unlikely because the fund makes distributions in December and June of each year and did not make distributions during the period of the large premium increase. In addition, neither trading volume nor intraday volatility appears to be unusually high or to rise around the days of distributions.
 - 27 Shleifer, A. and Vishney, R. (1997) The limits of arbitrage. *Journal of Finance* 52(1): 35–55. These authors emphasize the idea that professional money managers are especially concerned about this risk because large transitory losses on arbitrage positions could cause investors to withdraw funds, which could force managers to liquidate positions after mispricings become more extreme.
 - 28 Traders who short the BEP fund are short S&P 500 covered calls, which is equivalent to buying S&P 500

puts synthetically. This position could be hedged by shorting S&P 500 index puts that have the same strike and expiry month of the call that the BEP fund is short.

- 29 Garman, M. and Klass, M.J. (1980) On the estimation of security price volatilities from historical data. *Journal of Business* 53(1): 67–78.
- 30 Abreu, D. and Brunnermeier, M. (2002) Synchronization risk and delayed arbitrage. *Journal of Financial Economics* 66(2): 341–360.
- 31 In addition, the fairly substantial increase in short positions to sizable levels suggests that the large run-up of the premium was not a result of the difficulty of finding BEP shares to short.