Performance of a Balanced Portfolio With Active Covered-Call Strategies

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This study investigates the performance of local and global investments with and without covered call option strategies over the period from January 2000 to December 2015. The Covered Call Strategy (CCS) is a common return enhancing strategy used in portfolio management. The strategy consists of simultaneously holding a long position in an asset and writing call options on that asset. The local investment are on the top twenty stocks from Australian market while the global investment is an international balanced portfolio. For covered call strategies, market option data from Australian Stock Exchange is used. The results show that under some constraints, using covered call strategies in general improves the risk-adjusted returns.

Keywords: option strategies, protective puts, covered-call, buy- write strategy, Equity Index Portfolio with option strategies, portfolio performance, portfolio management

INTRODUCTION

In a Covered Call Strategy (CCS), the number of call options to be written is usually covers a (small) percentage of the underlying assets held, depending on the investor's level of risk aversion. Writing call options on an index and holding that index is known as a *passive covered call strategy*. Alternatively, an *active covered call strategy* involves holding a portfolio of assets and writing call options on the individual assets in the portfolio. Whilst there is a large body of research on the performance of the passive covered call strategy, the literature on the performance of active covered call strategies is limited. This is mostly due to the difficulty in obtaining option trading data.

This paper contributes to the literature by investigating the performance of active covered call strategies applied to different portfolios. The strategy was applied to an Australian equity portfolio (local) and an international portfolio (global) over a period of 16 years. The performance of these portfolios was also compared to similar portfolios without the covered call strategies. We compare the *equity portfolio with a covered-call strategy* (EPCC) to an *equity portfolio* (EP). Similarly, we compare the *international-balanced portfolio with covered call strategy* (IBPCC) to *international- balanced portfolio* (IBP). We explore the performance of the portfolio in *bull* and *bear market* conditions. The results indicate that a covered call strategy improves the performance of both local and global portfolios. We employ ASX option trading data for almost all options used. The data used in the study spans the period January 4, 2000 to December 17, 2015 where all portfolios are rebalanced quarterly. The local portfolio is constructed from S&P/ASX20 stocks, using the weights of the index on the rebalance dates. Namely, at each rebalance date, the stocks held are sold, the option positions are closed, a new portfolio of the current S&P/ASX20 stocks is constructed and new options on the currently held stocks are written.

The global portfolio used is a diversified portfolio consisting of international stocks (25%), fixed income (20% domestic and foreign), property (10%), cash (5%) and Australian stocks (40%) (see Section 2 for more details) where the "Australian stocks" component is the equity portfolio. We compare the performance of the EPCC against the EP, the IBPCC against the IBP and the EPCC minus the EP against the IBPCC minus the IBP. This is done to ascertain the impact of the covered call strategy.

A substantial amount of research exists on the use of covered call strategies using index call options. Merton et al. (1978) investigated the performance of an equally weighted, fully hedged covered call option strategy applied to a portfolio of US stocks with option prices calculated using the Black and Scholes (Black & Scholes (1973)) formula. They found that covered calls reduce both risk and return, while introducing negative skewness that becomes positive when deep out-of-the- money options are used. Clarke (1987) applied stochastic dominance theory to show that covered call and protective put strategies can dominate the stock-only portfolio even if the corresponding option prices are calculated using the Black-Scholes formula.

Whaley (2002) describes the construction of the Buy Write Monthly index (BXM), introduced by the Chicago Board Options Exchange (CBOE) and constructed a covered call portfolio using the S&P 500 index and option trading data over the period June 1988 to December 2001. Using BXM as a benchmark, Whaley concluded that the BXM outperformed the S&P 500 index on a risk-adjusted basis during the observation period and negative skewness associated with BXM returns is due to the non-linear nature of the payoff of the written call options. SIRCA (2004) replicate the study of Whaley (2002) using data for the Australian market using data for the period December 1987 to December 2002. SIRCA (2004) construct a portfolio with a long position on the index with simultaneous writing a just out of the money index call option and note that risk-return characteristics of a buy-write portfolio dominate the index portfolio. The findings of SIRCA (2004) are even stronger than comparative results from the US market. O'Connell & O'Grady (2014) apply a modified version of the Whaley's approach and find that, on all performance measures, the buy-write strategy outperforms the index-only portfolio.

There is significant theoretical and empirical evidence in the literature, suggesting that the portfolios with covered call strategies (CCS) outperform the underlying portfolios and exhibit lower volatility and downside risk. For example, see Merton et al. (1978), Clarke (1987), Morard & Nacini (1990) and Isakov & Morard (2001) for an exposition of theoretical results. Empirical studies include Isakov & Morard (2001) who provide evidence on the Swiss market, Morard & Nacini (1990), Schneeweis & Spurgin (2001), Kapadia & Szado (2007, 2012), Hoffmann & Fischer (2012), Israelov & Nielsen (2014), Simon (2014) study covered call strategies in the American market. Brace & Hodgson (1991), El-Hassan et al. (2004), Mugwagwa et al. (2012) analyze covered calls in the Australian market. Our research extends the empirical evidence on the Australian market with a longer study period, using trading data from January 2000 to December 2015. The previous literature on the Australian market covers the periods 1986–1987 in Brace & Hodgson (1991), El-Hassan et al. (2004) use option trading data over the period 1997–2004, and Mugwagwa et al. (2012) use data over the period 1995–2006.

Despite large volume of research on covered call strategies using index options, there is little research on active covered call strategies involving individual stocks: Morard & Nacini (1990) (data over 5 years), Isakov & Morard (2001) (data over 6.5 years), El-Hassan et al. (2004) (data over 7 years) and Mugwagwa et al. (2012) (data over 11.8 years).

In this paper, we apply *active covered call* strategies, using Australian stock and option trading data over the period of 16 years, under bull and bear market conditions. Further, we extended our equity portfolio to an international-balanced portfolio and examined the effects of covered call strategies in a diversified portfolio setting.

Our analysis consists of calculating summary statistics, portfolio measures (Sharpe, Adjusted Sharpe and Sortino ratios), performance measures (Jensens' Alpha, Treynor, M squared, Upside Potential, Downside potential, Omega ratio) and testing for first-order stochastic dominance. The distribution of returns for a portfolio with a covered call strategy (so any other option strategy) deviate from normal distribution. The normality is distorted with respect to the optioned percentage. In the performance analysis of such portfolios, the non-normality property should be kept in mind. The stochastic dominance method is often used for non-normal time series. We maintained the optioned percentage as 25% of the stock holdings in this research to prevent extreme skewness. Moreover, we test our portfolios for first-order stochastic dominance.

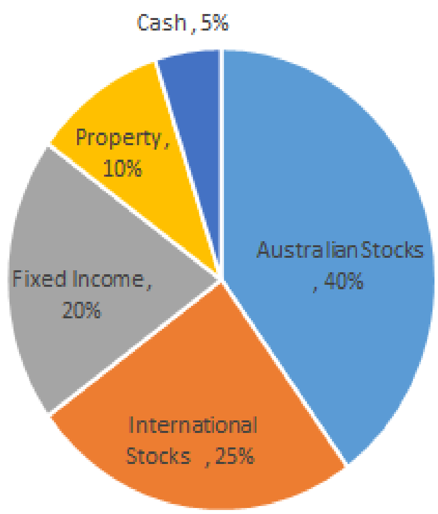
DATA

In this study, we analyze four portfolios:

1. an international-balanced portfolio (IBP),
2. an international-balanced portfolio with covered call strategy (IBPCC),
3. an Australian equity portfolio (EP) and,
4. an Australian equity portfolio with covered call strategy (EPCC).

The balanced portfolio weights are as shown in Figure 1.

FIGURE 1
INTERNATIONALLY BALANCED PORTFOLIO (IBP) WEIGHTS



For the purpose of this analysis, daily price data was collected over the period January 4, 2000, to December 17, 2015, using four data sources: IRESS, DataStream, SIRCA and Reserve Bank of Australia (RBA), as detailed in Table 1.

TABLE 1
ASSET CLASSES AND DATA SOURCES

Asset Classes	Data Source	Representative
Australian Stocks 40%	IRESS, DataStream	S&P/ASX20 constituents
International Stocks 25%	IRESS, DataStream	MSCI World Ex Australian Price Index (unhedged)
Fixed income 10%	IRESS, DataStream	UBS Warburg Government Bond Index Australia
Fixed income 10%	IRESS, DataStream	JP Morgan Global Government Bond (hedged)

Property 10%	DataStream	ASX REIT index (XPJ)
Cash 5%	RBA	Interbank Overnight Cash Rate
Call options	SIRCA	Call Options on S&P/ASX20 stocks

The Australian equity (EP) component of the portfolio is constructed from S&P/ASX20; the 20 largest stocks by market capitalization in the Australian market. The stocks and the weights of the stocks occurring in S&P/ASX20 change daily. There are 44 Australian stocks occurring in S&P/ASX20 with non-zero weights on the rebalancing dates from January 4, 2000, to December 17, 2015 (see Figure 10 in Appendix for rebalancing dates). We calculate returns for each of our portfolios on a daily, monthly, quarterly, and yearly basis for the analysis (not applying the square root rule of time to avoid any possible statistical error, see Lo (2002)). In calculating the returns, the stocks and weights of the Australian equity component are fixed between rebalancing dates, but the stock prices are incorporated daily.

We apply the covered call strategy (CCS) to the EP with the following assumptions:

- **Quarterly rebalancing period:** This choice is consistent with a preference by Australian investors for options with the maturity of around three (3) months. Firstly, the Australian options market is an illiquid one (see O'Connell & O'Grady (2007)). As mentioned in Mugwagwa et al. (2012), many of the options do not trade each day, due to the limited number of participants and large number of options. These options often appear as zero premium options. In the very few data cases where these option prices were required for the study, the Black-Scholes option pricing model was used to approximate the value of these thinly traded options [1]. Secondly, there is evidence that quarterly rebalancing periods offer better returns for the buy-write strategy in the Australian market (see Mugwagwa et al. (2012)).
  The rebalance dates for this study are chosen with respect to the expiry dates of the options in the Australian market, as shown in Figure 10, Appendix.
- **Optioned percentage, 25%:** In practice, the "allowable" optioned percentage varies be- tween investors but is often restricted to a small percentage of the asset holding. We set the maximum limit on the percentage of each asset held that can be optioned as 25% of the holding. That is, it is possible to write options on up to 25% of the holding of each stock in the portfolio. This ensures that only part of the underlying position will be called away if the written options are exercised. This bounds the losses suffered due to the written options to 25% of the asset holdings. Bookstaber & Clarke (1985) examined the return distributions of a portfolio, using the covered call strategy with call options written on 25%, 50% and 75% of the shares in the portfolio. As the percentage of assets optioned increases, the skewness and kurtosis increase and so the distribution deviates further from the normal distribution. Therefore, the mean-variance analysis would not be a useful basis for the performance evaluation of the portfolios with option strategies written on a large percentage of held assets. Hence, the choice of 25% optioned percentage is a justifiable assumption.

For this study we were required to write approximately 1280 different call options (20 stocks over 64 quarterly rebalancing periods). Initially, we intended to write call options on each stock in our Australian equity portfolio. Given that the Australian options market is illiquid, this turned out to be an unrealistic task. One of the major obstacles in this study was the lack of availability of settlement prices on some options used. Despite this difficulty, we managed to restrict the use of Black-Scholes option pricing formula to calculate option values to less than 4% of all options used. Furthermore, the results of Kapadia & Szado (2012) indicate that, if the option was written at the Black-Scholes price associated with the realized volatility, the buy-write strategy would underperform the index over the sample period, February 1996–March 2011. Namely, the outperformances of a covered call strategy are closely related to violation of the efficient market hypothesis (EMH) (see the section titled Discussion on Volatility later in this paper).

In each rebalancing period, the covered call strategy (CCS) introduces an extra cash flow from the option premium. If an option that was written at the previous rebalance period is exercised at the current rebalance date, then the intrinsic value, namely the spot price minus strike amount (exercise expense), occurs as a negative cash flow in the portfolio account of assets with CCS. Note that the exercise expense amount is usually much greater than the option premium. If a written option on a large cap stock is exercised, then a substantial loss may occur. To maximize the returns using the CCS, one would be required to write options with high premiums, but with a low possibility of exercise. Hence, the choice of the strike (or moneyness percentage) is imperative in applying the strategy.

The call options used to implement CCS ranged in moneyness from 4.4% to 10% and maturity from 80 to 100 days. This ensures the maximum use of the option trading data and minimal use of Black-Scholes option pricing formula.

For the purpose of performance analysis, we require a proxy for the risk-free rate and an appropriate benchmark. We approximate the risk-free rate by using the holding period return on 90-day Bank accepted bills. We use S&P/ASX200 as a benchmark for equity portfolios EPCC and EP. For international-balanced portfolios, we have no proxy market and thus such portfolio measures are not available for IBP and IBPCC. However, we also calculate the first-order Stochastic dominance for EP versus EPCC and for IBP versus IBPCC.

METHODOLOGY

In this section, we explain the implementation of the covered call strategies used in this study (for the mathematical details of these calculations, see Appendix).

The rebalancing process of the equity portfolio (EP) and the equity portfolio with covered call strategy (EPCC) is recursive. Note that the set of the top 20 stocks appearing in Australian Stock Exchange changes daily and so do their weights while the constituents of S&P/ASX20 are officially updated quarterly. Suppose we have dollar amount $I to invest initially. If the weight of a stock in S&P/ASX20 at the initial investment date is x%, then we invest x% of $I in that stock. We hold this position until the next rebalance date. At the next rebalance date, we sell the stocks held at the price on that date and invest the total amount of funds in the new set of the stocks appearing in S&P/ASX20 at that date with respect to their weights.

The value of the equity portfolio with a covered call strategy (EPCC) is calculated in a similar manner by adding the option account to the equation. As mentioned previously, we restrict the optioned percentage to 25% of the holding of each stock. On each of the rebalance dates, the holding of the underlying stocks, the strike of the options and the number of the options written change.

The balance of the option account at the current period (rebalance date) is calculated as:

- The income received from the option premium at the current rebalance period; plus,
- interest earned on the option premium received at the previous period, up to the current period minus,
- the option buyback expense at the current period; minus,
- the option exercise expenses at the current period.

Option premiums written are subject to interest income between rebalancing dates. At each rebalance date, the option account, including interest earned from the previous period, is incorporated into the portfolio account at the current period.

Options with expiry dates falling after the current rebalance date must be bought back at the current market price. We refer to this expense as the buyback expense. If an option is subject to buy back, then at the current rebalance date, we would need to buy back the options for the underlying stock with the expiry and strike matching the written options. Hence, the buyback expense is the number of options written on the stock at the previous period multiplied by the option price at the current period.

If the option is not bought back at the current period and the stock price is greater than the strike of the option, then the option will be exercised. We note that exercise expenses are usually much larger than the gains made from the premium of the written call options.

The international-balanced portfolio (IBP) is constructed from the daily data as in Table 1 with the weights shown in Figure 1. The returns and performance measures are calculated on a daily, monthly, quarterly, and yearly basis.

RESULTS

Returns and Performance of Australian Equity Portfolio With and Without Covered Call Strategies

Figure 2 shows the performance of S&P/ASX200 over the period January 2000–December 2015. During the study period, financial markets experienced extreme volatility and large falls in prices of many stocks, commencing in September 2007. This period is well known as the period of the Global Financial Crisis (GFC). Figure 2 shows that the S&P/ASX200 also suffered large falls over the period September 2007 to March 2009. However, over the remainder of 2009, the index reserved some of its losses and many of the stocks held in the equity portfolio experienced steep price rises. Consequently, many written options were exercised by the holders over this period and the option account balance became negative due to large option exercise expenses (see Figure 3). Table 2 shows examples of steep price increases experienced by some of the large-weighted stocks held in the equity portfolio. These price rises were in excess of 30% over the quarter Jun–Sep 2009.

FIGURE 2
QUARTERLY AVERAGE OF S&P/ASX200 INDEX

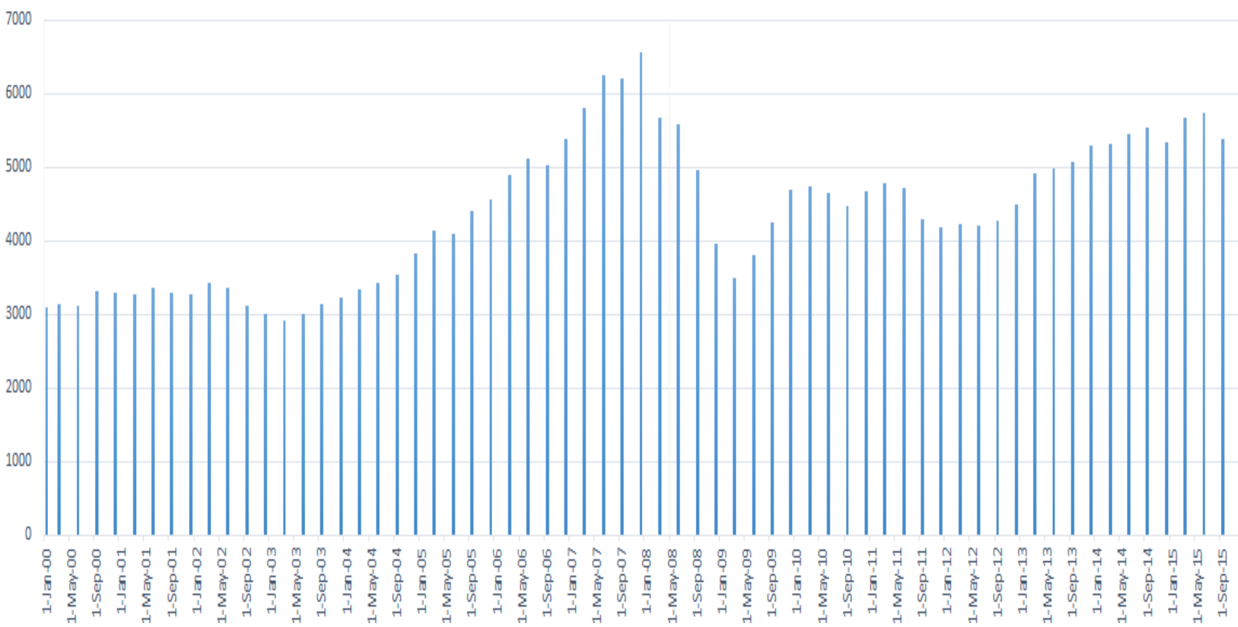
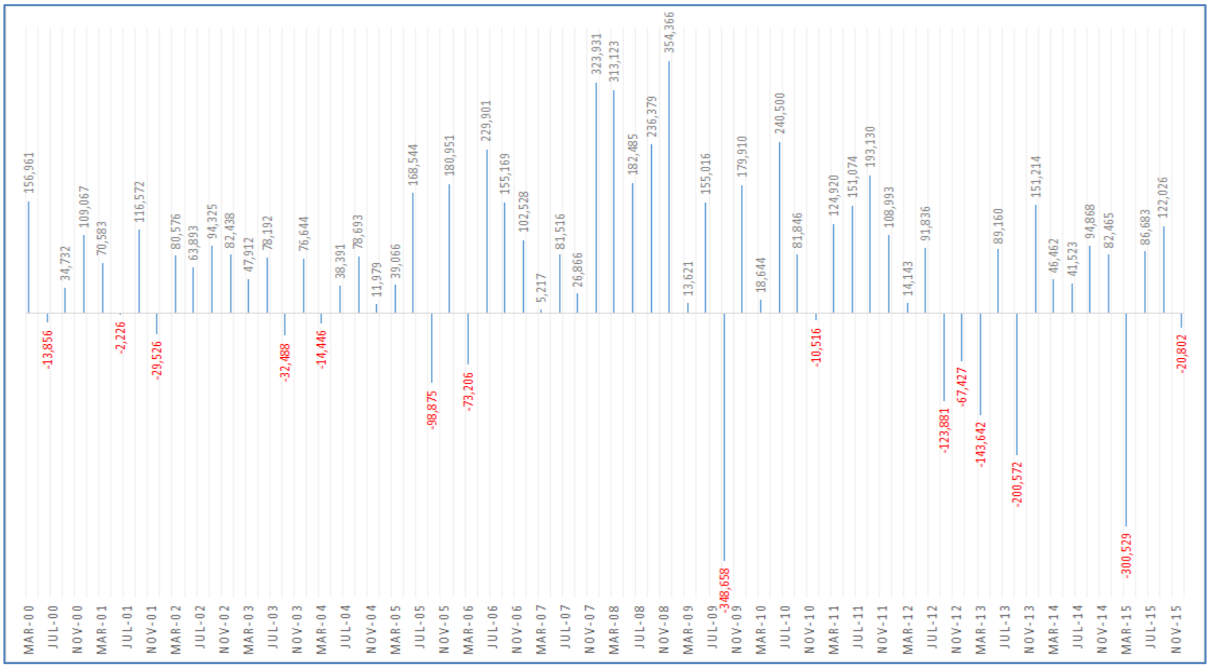


TABLE 2
CHANGES IN PRICES OF SOME STOCKS DURING THE QUARTER JUN-SEP 2009

	ANZ	CBA	MBL	NAB	WBC
JUN 2009	16.05	37.39	35.34	20.44	19.29
SEP 2009	23.49	49.79	55.94	28.40	25.27
CHANGE IN %	46%	33%	58%	39%	31%

FIGURE 3
OPTION PROFITS AND LOSSES WITH INTEREST EARNINGS



This is one of the rare scenarios when the return of EP is higher than return of EPCC. Over the 16-year holding period, 81.3% of times, the quarterly returns of EPCC were above the quarterly returns of EP. EPCC provided 24% better returns than EP over the 16-year holding period. The outperformance of EPCC over EP is also evident in the Figures 4, 5 and statistical results in Table 3.

FIGURE 4
ANNUAL RETURNS OF EPPC AND EP

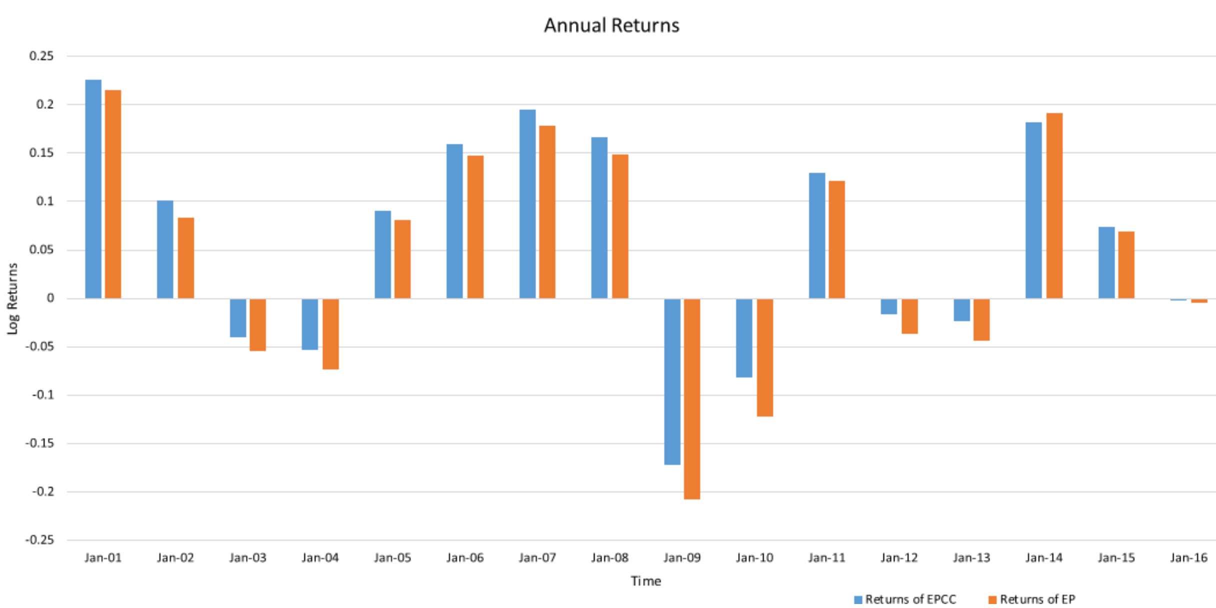


FIGURE 5
QUARTERLY CUMULATIVE RETURNS OF EPCC AND EP

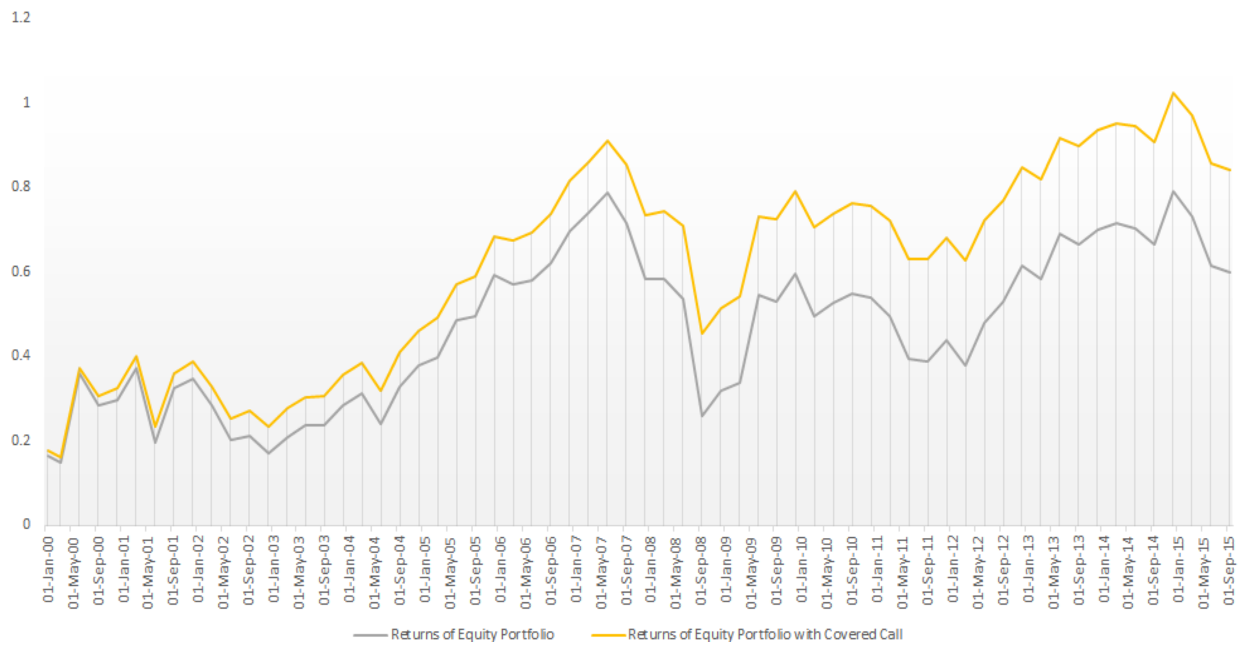


Table 3 shows the statistical results for the returns of the EPCC compared with the returns of the EP. Our analysis demonstrates that the EPCC produces better returns than the returns of EP for each return interval considered (daily, monthly, quarterly, and yearly). For example, the mean annual return of EPCC is 6% versus 4% for EP; the volatility of EPCC is approximately 1% less than the annual volatility of EP. Furthermore, the downside risk of EPCC is 1.6% lower than the downside risk of EP. The Sharpe ratio is a standard measure of risk-adjusted performance. The higher the Sharpe ratio, the better the risk-adjusted performance. The risk-adjusted returns of EPCC are higher than those of EP for each periodic interval. In particular, the annual risk- adjusted return of EPCC is 22%, compared to a risk-adjusted return of 8.6% for EP. The covered call strategy increases the risk-adjusted return of the equity portfolio by 13%. The Adjusted Sharpe ratio relaxes the assumption of normality by accounting for the skewness and kurtosis in the return's distribution. According to the Adjusted Sharpe ratios, we also conclude that the EPCC outperforms the EP. The Sortino ratio measures excess return per unit of downside risk and is a more appropriate measure of performance when the returns distribution is skewed as in the case for EPCC. The Sortino ratio of EPCC is 24% higher than that of the EP on an annual basis. From the results of the Sharpe, the Adjusted Sharpe and Sortino ratios, we conclude that covered call strategies provide better returns, adjusted by both total risk and downside risk. In Table 3, $P(R < 0)$ denotes the probability of negative returns. The probability of negative return is 5% lower for the EPCC than for the EP on an annual basis.

Table 3 also contains several portfolio performance measures applied to the EPCC and the EP. We calculate Jensen's Alpha, Treynor measure, M Squared, Upside potential, Downside potential and Omega ratios (see Appendix for the Omega Ratio formula). The performance advantage of EPCC persists when we use these portfolio measures. The portfolio measures, Jensen's alpha, the Treynor measure and M Squared depend on the selection of a benchmark portfolio. The proxy for the market (the benchmark portfolio) is assumed to be the S&P/ASX200. Jensen's alpha assesses the marginal return associated with unit exposure to a given strategy (their excess return above the benchmark). For each periodic interval, the Jensen's alpha of EPCC is larger than that of EP, indicating the outperformance of the EPCC over the EP. On an annual basis, the Jensen alpha is 2% for EPCC, compared to 1% for EP. The Treynor ratio is a measure of reward for volatility, calculated as the excess return divided by the systematic risk (beta). On an annual basis, the EPCC has a 2% higher Treynor ratio than EP, supporting the outperformance of the

EPCC over the EP. The M squared measure is a risk-adjusted return and is useful for comparing portfolios with different levels of risk against the market portfolio. The EPCC demonstrates higher M Squared values than that of the EP for each periodic interval analyzed. The Omega ratio (see Appendix) is calculated as the upside potential divided by the downside potential where the target return is assumed to be the risk-free rate. The Omega ratio is the probability weighted ratio of gains to losses, relative to the target return. The higher the Omega ratio, the better the performance. On an annual basis, the Omega ratio for EPCC is 1.68, while it is 1.24 for EP.

TABLE 3
DESCRIPTIVE STATISTICS AND PORTFOLIO MEASURES OF EPCC AND EP
(D-DAILY, M-MONTHLY, Q-QUARTERLY, Y-YEARLY)

	D R^{EP}	D $R^{EP\ CC}$	M R^{EP}	M $R^{EP\ CC}$	Q R^{EP}	Q $R^{EP\ CC}$	Y R^{EP}	Y $R^{EP\ CC}$
STATISTICS								
MEAN	0.0001	0.0002	0.0031	0.0043	0.0094	0.0132	0.0434	0.0584
STDEV	0.0122	0.0123	0.0388	0.0389	0.0838	0.0794	0.1242	0.1165
SKEWNESS	2.86	3.23	0.15	0.30	-0.38	-0.35	-0.42	-0.32
EXCESS KURTOSIS	84.28	95.84	3.22	3.79	1.79	1.78	-0.75	-0.88
SEMIVARIANCE	0.0001	0.0001	0.0017	0.0016	0.0082	0.0076	0.0186	0.0159
SHARPE RATIO	0.0010	0.0057	0.0058	0.0384	0.0131	0.0615	0.0855	0.2197
ADJ SHARPE RATIO	0.0010	0.0057	0.0058	0.0384	0.0131	0.0613	0.0850	0.2175
DOWNSIDE RISK	0.0083	0.0083	0.0278	0.0269	0.0604	0.0554	0.0867	0.0707
SORTINO RATIO	0.0014	0.0085	0.0082	0.0555	0.0182	0.0881	0.1225	0.3622
MAX RETURN	0.2914	0.3045	0.1957	0.2072	0.2094	0.2118	0.2153	0.2264
MIN RETURN	-0.1182	-0.1182	-0.1105	-0.1042	-0.2790	-0.2561	-0.2073	-0.1726
$P(R<0)$	44%	39%	44%	39%	44%	39%	44%	39%
PERFORMANCE MEASURES								
JENSEN ALPHA	-0.0001	0.0000	0.0005	0.0017	0.0013	0.0051	0.0079	0.0231
TREYNOR	0.0000	0.0001	0.0002	0.0016	0.0013	0.0061	0.0123	0.0322
M SQUARED	0.0001	0.0002	0.0030	0.0041	0.0091	0.0120	0.0437	0.0609
UPSIDE POTENTIAL	0.0040	0.0040	0.0143	0.0150	0.0316	0.0320	0.0624	0.0676
DOWNSIDE POTENTIAL	0.0039	0.0039	0.0141	0.0135	0.0303	0.0271	0.0503	0.0403
OMEGA RATIO	1.0030	1.0178	1.0161	1.1105	1.0430	1.1803	1.2397	1.6783

Table 3 also contains several portfolio performance measures applied to the EPCC and the EP. We calculate Jensen's Alpha, Treynor measure, M Squared, Upside potential, Downside potential and Omega ratios (see Appendix for the Omega Ratio formula). The performance advantage of EPCC persists when we use these portfolio measures. The portfolio measures, Jensen's alpha, the Treynor measure and M Squared depend on the selection of a benchmark portfolio. The proxy for the market (the benchmark portfolio) is assumed to be the S&P/ASX200. Jensen's alpha assesses the marginal return associated with unit exposure to a given strategy (their excess return above the benchmark). For each periodic interval, the Jensen's alpha of EPCC is larger than that of EP, indicating the outperformance of the EPCC over the EP. On an annual basis, the Jensen alpha is 2% for EPCC, compared to 1% for EP. The Treynor ratio is a measure of reward for volatility, calculated as the excess return divided by the systematic risk (beta). On an annual basis, the EPCC has a 2% higher Treynor ratio than EP, supporting the outperformance of the EPCC over the EP. The M squared measure is a risk-adjusted return and is useful for comparing portfolios with different levels of risk against the market portfolio. The EPCC demonstrates higher M Squared values than that of the EP for each periodic interval analyzed. The Omega ratio (see Appendix) is calculated as the

upside potential divided by the downside potential where the target return is assumed to be the risk-free rate. The Omega ratio is the probability weighted ratio of gains to losses, relative to the target return. The higher the Omega ratio, the better the performance. On an annual basis, the Omega ratio for EPCC is 1.68, while it is 1.24 for EP.

First Order Stochastic Dominance Test

Stochastic dominance gives a partial ordering of statistical distributions. It is known that stochastic dominance analysis is theoretically superior to mean variance analysis when the returns distribution is not normal, as stochastic dominance makes no assumption about the form of the distribution 2. We apply first-order stochastic dominance analysis to the annual returns of EPCC and the EP and, similarly those of the IBPCC against the IBP. First-Order Stochastic Dominance analysis of the rate of the returns of two portfolios is straightforward: rank the returns in ascending order, assign equal probability for each return in the series, calculate the empirical distributions corresponding to each portfolio and compare them statistically (see Meyer et al. (2005) for comparison of mean- variance versus stochastic dominance, Levy (1998) for stochastic dominance criteria, Sriboonchitta et al. (2010) for comprehensive applications of stochastic dominance to finance, risk and economics). We found that the annual returns of the EPCC stochastically dominate the annual returns of the EP, and similarly the annual returns of the IBPCC stochastically dominate the returns of IBP. We support these results by Figure 6 and Figure 7. Figure 6 shows that the EPCC outperforms the EP, while Figure 7 shows that the IBPCC outperforms the IBP.

FIGURE 6
FIRST ORDER STOCHASTIC DOMINANCE OF RETURN DISTRIBUTIONS OF EPCC AND EP

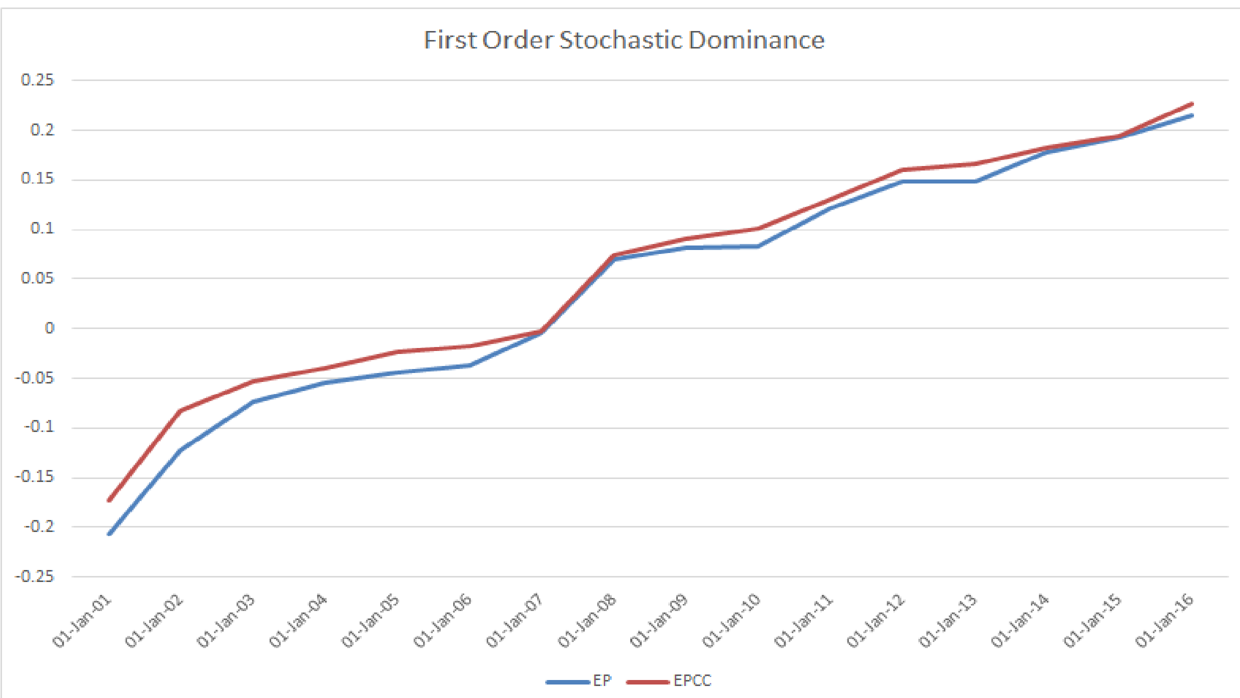
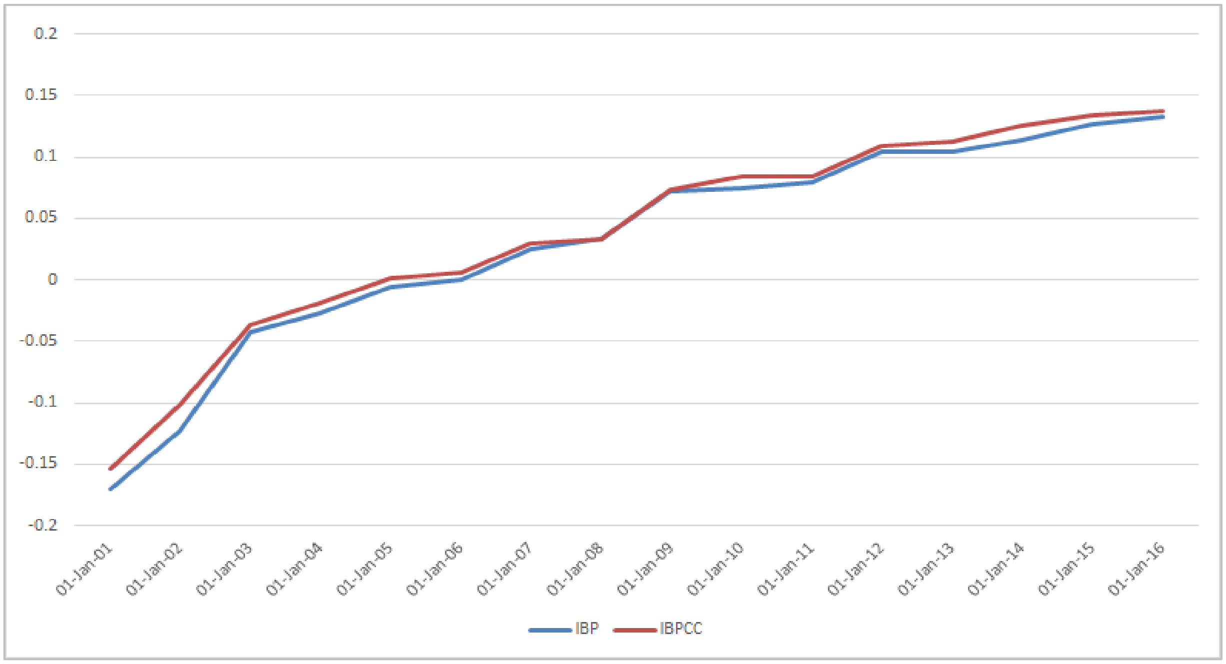


FIGURE 7
FIRST ORDER STOCHASTIC DOMINANCE OF RETURN DISTRIBUTIONS OF IBPCC AND IBP



Covered Call Strategies Under Different Market Conditions

It is useful to analyze the performance of the covered call strategies under various market conditions. Bry & Boschan (1971) introduce an algorithm to identify the business cycles, by identifying the turning points from peaks to troughs and vice versa. Their work is known as BB-method and has been extended by many researchers thereafter. Harding & Pagan (2002) modified BB-method. For analysis of bull and bear markets, we refer to Pagan & Sossounov (2003). Gonzalez et al. (2006) compared BB-methods and a two-state mean return model (CC-methods). We tested our market data, S&P/ASX200 from 2000 to 2016 using the CC-method by using Gonzalez et al. (2006) and under modified BB-method by using the model of Harding and Pagan. The results of the modified BB-method (Harding & Pagan (2002)) gave a better representation of the data and was chosen for the analysis in this study.

TABLE 4
STATISTICS OF RETURNS OF EPCC MINUS RETURNS OF EP

	#Bull: #Bear	Mean	StDev	Min	Max	t-value	significance	Mean Bull	Mean Bear
2000–2016 (64Q)	43:21	0.0038	0.0063	-0.0165	0.0228	4.77	0.000	0.0023	0.0068
2000–2008 (32Q)	23:9	0.0042	0.0047	-0.0054	0.0137	5.07	0.000	0.0034	0.0058
2008–2016 (32Q)	20:12	0.0033	0.0076	-0.0165	0.0228	2.47	0.006	0.0008	0.0075

As shown in Table 4, the average outperformance of EPCC over EP is 0.4% over a 16-year period, 0.2% over the bull periods and 0.7% over the bear periods. This result is as expected as covered call strategies are known to perform better during bear periods when the exercise expenses would be minimal. Table 4 also shows the descriptive statistics of the returns of EPCC minus the returns of EP over the entire period 2008 to 2016, as well as the subperiods. The results obtained are consistent with the literature, indicating that covered call strategies give better returns during bear market conditions. Figure 8 shows the quarterly Bull and Bear periods, the returns of EPCC and the returns of EP.

FIGURE 8
RETURNS OF EPCC AND EP UNDER BULL AND BEAR MARKET CONDITIONS

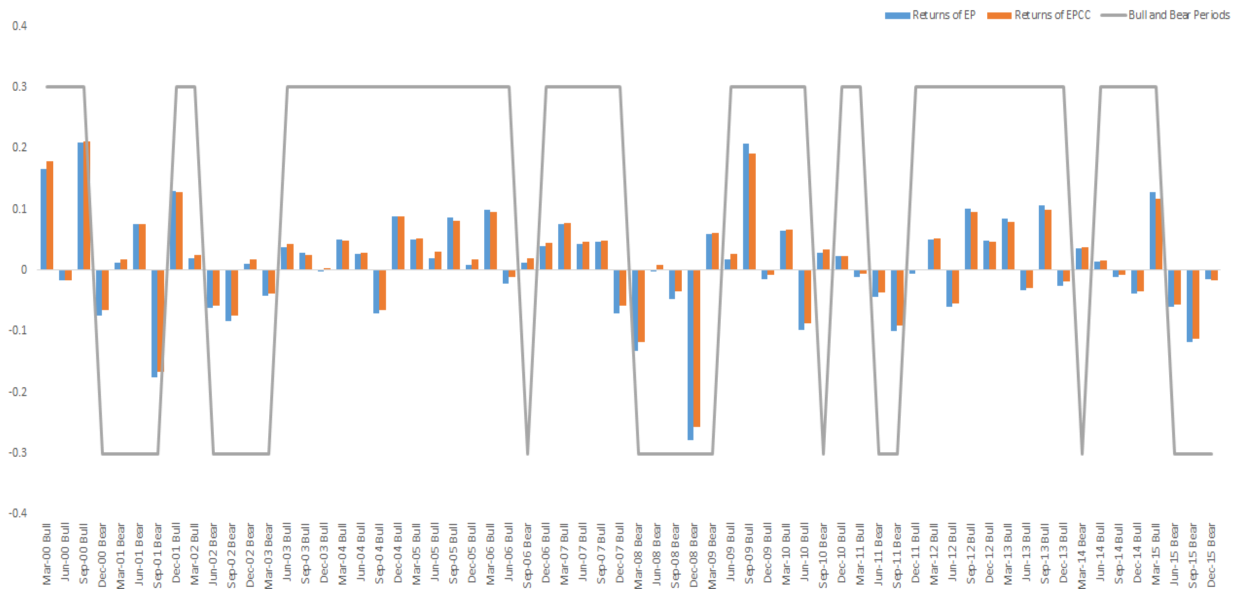


FIGURE 9
AVERAGE RETURN DIFFERENCES BETWEEN EPCC AND EP UNDER BULL AND BEAR PERIODS OVER 4 YEARS, 8 YEARS AND ENTIRE PERIOD

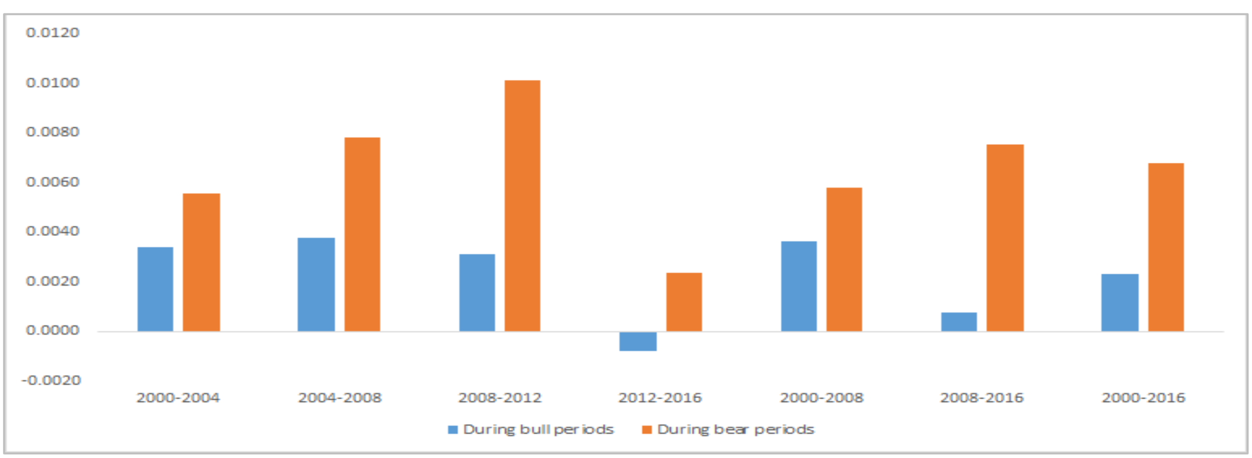


Figure 9 shows the average return differences between EPCC and EP during bull and bear periods over subintervals: 4 years, 8 years, and the entire period. It indicates that covered call strategies produce better mean returns during bear market conditions.

Furthermore, we present additional graphs in the Appendix showing the performance of the EPCC against the EP under bull and bear market conditions.

Returns and Performance of the International Balanced Portfolio With and Without Covered Call Strategies

We present the statistical analysis of the returns on the international-balanced portfolio with the covered call strategy (IBPCC) relative to the internationally balanced portfolio (IBP) in Table 5. Like EPCC and EP, Table 5 shows that IBPCC outperforms the IBP under all measures, but with smaller margins.

TABLE 5
DESCRIPTIVE STATISTICS OF IBPCC AND IBP
(D-Daily, M-monthly, Q-Quarterly, Y-Yearly)

	D R^{IBP}	**D** $R^{IBP\ CC}$	**M** R^{IBP}	**M** $R^{IBP\ C}$	**Q** R^{IBP}	**Q** $R^{IBP\ CC}$	**Y** R^{IBP}	**Y** $R^{IBP\ CC}$
STATISTICS								
Mean	0.0001	0.0001	0.0023	0.0030	0.0072	0.0091	0.0312	0.0389
StDev	0.0064	0.0068	0.0232	0.0240	0.0404	0.0405	0.0889	0.0858
Skewness	1.33	1.32	-0.49	-0.38	-0.73	-0.61	-0.97	-0.87
Excess Kurtosis	35.31	34.38	2.04	1.85	2.70	2.65	0.37	0.19
SemiVariance	0.0000	0.0000	0.0007	0.0007	0.0020	0.0020	0.0101	0.0086
Sharpe Ratio	-0.0033	0.0010	-0.0216	0.0049	-0.0270	0.0193	-0.0174	0.0721
Adj Sharpe Ratio	-0.0033	0.0010	-0.0217	0.0049	-0.0271	0.0193	-0.0175	0.0714
Downside Risk	0.0045	0.0047	0.0178	0.0180	0.0315	0.0303	0.0718	0.0642
Sortino Ratio	-0.0048	0.0015	-0.0282	0.0065	-0.0347	0.0258	-0.0216	0.0963
Max Return	0.1219	0.1280	0.0909	0.0963	0.1286	0.1345	0.1323	0.1375
Min Return	-0.0503	-0.0503	-0.0816	-0.0788	-0.1234	-0.1186	-0.1699	-0.1540
$P(R < 0)$	39%	36%	39%	36%	39%	36%	39%	36%

Table 6 compares the EPCC and the EP with the IBPCC and the IBP. As a result of diversification, the IBP and the IBPCC have lower returns and lower risks, compared with the EPCC and the EP. Table 6 displays the statistical differences between the returns of EPCC and EP (Column REPCC − REP), and the statistical differences between the returns of IBPCC and IBP (Column RIBPCC − RIBP). The margins in RIBPCC − RIBP are smaller than the margins in REPCC – REP. For example, for the downside risk, 0.001 versus −0.005. In summary, the positive effects of CCS decrease when the portfolio is more diversified. For comparison, we also add a histogram and Mean-Variance graph for all examined portfolios in Appendix, Figure 14, and Figure 16.

TABLE 6
DESCRIPTIVE STATISTICS OF EPCC MINUS EP VERSUS IBPCC MINUS IBP, BASED ON QUARTERLY RETURNS

	R^{EP}	R^{EPCC}	$R^{EPCC} - R^{EP}$	R^{IBP}	R^{IBPCC}	$R^{IBPCC} - R^{IBP}$
Mean	0.009	0.013	0.04	0.0073	0.0095	0.002
StDev	0.084	0.079	-0.004	0.040	0.041	0.000
Skewness	-0.382	-0.351	0.032	-0.725	-0.608	0.117
Excess Kurtosis	1.788	1.777	-0.011	2.704	2.649	-0.056

SemiVariance	0.008	0.008	0.001	0.002	0.002	0.000
Sharpe Ratio	0.013	0.061	0.048	-0.027	0.019	0.046
Adj Sharpe Ratio	0.013	0.061	0.048	-0.027	0.019	0.046
Downside Risk	0.060	0.055	-0.005	0.031	0.030	-0.001
Sortino Ratio	0.018	0.088	0.070	-0.035	0.026	0.061
Max Return	0.209	0.212	0.002	0.129	0.134	0.006
Min Return	-0.279	-0.256	0.023	-0.123	-0.119	0.004
$P(R < 0)$	0.438	0.391	-0.047	0.391	0.359	-0.031

DISCUSSION

Discussion on Optimal Covered Call Strategy

There are several empirical studies that discuss the optimal choice of moneyness for the CCS, (see, for example Hill et al. (2006) and Mugwagwa et al. (2012)), but there are no theoretical results in the literature. If the stock price is expected to increase significantly, then it is optimal to write call options with high strike (high moneyness), as it would reduce the risk of exercising the option at the next rebalancing period. In that case, as high strike lowers the option premium, the return from the option premium decreases. If the stock price is expected to fall, then it is reasonable to write the nearest OTM call options to maximize the option premium income, while expecting the probability of exercise to be low. When stock price volatility is high, then minimizing the risk of exercise is a more appropriate strategy than maximizing the option premium income.

Hill et al. (2006) propose a dynamic strike strategy for overwriting S&P500 options. They propose the use of OTM S&P500 options with high strike price in more volatile markets and a lower strike price in quieter markets. Given a target probability of exercise, one can obtain the strike price from the option's implied volatility. They conclude their results by recommending covered call strategies with at least 2% out of the money or with a 30% or less probability of exercise.

Mugwagwa et al. (2012) empirically examine the optimality level of out of moneyness for the covered call strategies. They conclude that "the highest profit was achievable for the 0–15% out of the moneyness level for the yearly portfolios".

Szado & Schneeweis (2010) suggest a practical model of determining the moneyness in covered calls used in the collar strategies. They formulate the call OTM moneyness as a base rate (2%) plus momentum signal plus macroeconomic signal. Momentum signal is based on simple moving aver- ages of the asset (index/portfolio). Macroeconomic signals indicate bull or bear market conditions by using simple moving averages of unemployment rates under expanding or contracting economic conditions. They empirically showed that their active strategy outperformed passive trading of QQQ ETF from 1999 to 2009.

Now we indicate a condition for the out of moneyness in a covered call strategy. The relation between the strike K and the level of out of moneyness x can be written as K = (1 + x) S0.

Under the Black-Scholes framework, we have:

$$S_T = S_0 \exp\left(\left(r - \frac{\sigma^2}{2}\right)T - \sigma W_T\right) \quad (1)$$

Here S_t is the stock price at time t, r is the risk-free rate, σ is the volatility of the stock, and W_t is the Weiner process at time t. Under the covered call strategy, as we write a call option on the stock, we do not want the option to be exercised at time T. Hence, we require that $S_T < K$. Substituting S_T from Equation 1, and $K = (1 + x) S_0$, we obtain:

$$\exp\left(\left(r - \frac{\sigma^2}{2}\right)T - \sigma W_T\right) < 1 + x \quad (2)$$

The left-hand-side of this equation can be estimated by calculating the implied volatility σ from the market data. The Weiner process corresponds to the uncertainty of the future asset price. Simulating for the Weiner processes and using the implied volatility, Equation 2 leads to a lower bound for the moneyness, x. On the other hand, for the optimal covered call strategy, we also want to maximize the call price (as writing on call options is an income for the portfolio holder with covered call strategy). Maximizing the call premium is equivalent to minimizing the value x satisfying Equation 2. This method gives a practical estimation for the level of out of moneyness. This feature has not been implemented in this study but will be the topic of a future project.

Discussion on Volatility

It is a simple fact that option overwriting is a version of selling volatility. Myth 3 Israelov & Nielsen (2014) says that "in order for there to be investment income or earnings, the option must be sold at a favorable price; the option's implied volatility needs to be higher than the stock's expected volatility". Brace & Hodgson (1991) found that the implied volatility of call options on index futures is greater than the realized volatility, suggesting that index call options are overpriced. If option writing strategies produce returns, then this would appear to be an Efficient Market Hypothesis (EMH) violation, as it would indicate mispricing of call premiums (see O'Connell & O'Grady (2014)). In our study, actively applied covered call strategies in the Australian Market for the period 2000–2016 produce a positive return. In the Australian Option market, the implied volatility is higher than the realized volatility. That implies that "OTM options are in general overpriced in the Australian Option market over the period 2000–2016". We note that, during 2012–2016, the performance of EPCC closely follows the performance of the EP (see Figure 13. After the GFC in 2008–2009, the market recovers around 2012.

CONCLUSIONS

This paper examines actively applied covered call strategies on individual stocks in S&P/ASX20 on the Australian market for the period 2000–2016 and the effects of such strategies on a diversified portfolio together with international assets. We constructed four portfolios; EP, EPCC, IBP and IBPCC (see Section 2), using trading data for covered call strategies. Given that the Australian Option market is illiquid, our equity portfolio with covered call strategy is constructed from various levels of moneyness 4.4%–10% and portfolios are balanced quarterly. Furthermore, we applied covered call strategies on only 25% of the equity value, as being consistent with practical applications. We analyzed the performance of these portfolios graphically and statistically under several portfolio performance measures.

Under the above assumptions, we found that the returns of EPCC in general are higher than the returns of EP. With respect to various portfolio measures, EPCC has a better risk-adjusted return than EP. Briefly, we showed that Equity Portfolio with the covered call strategy outperforms the stocks only portfolio in the Australian market. Similarly, international-balanced portfolio with covered call strategy outperforms the portfolio without CCS but within a smaller margin than that of Equity Portfolios. The first-order Stochastic Dominance analysis also supports these results. As an extension to this study, we plan to investigate the impact of the optimal moneyness of the options used in the covered call strategies.

ENDNOTES

1. To reduce the missing option premiums to a reasonable level, we had to use the Black-Scholes option formula to calculate 53 option premiums among 1280 different option writings. Namely, only 4% of option premiums are calculated and so 96% of the option premiums are market data.
2. First order stochastic dominance cannot be applied when the cumulative distributions of the returns of the portfolios cross over. That was not the case for the portfolios studied in this paper.
3. SPI stands for Sydney Futures Exchange All Ordinaries Share Price Index.
4. BXM stands for the Chicago Board Option Exchange (CBOE) S&P 500 Buy Write Index.
5. BXY stands for the CBOE S&P 500 2% OTM Buy Write Index.
6. SPXCC stands for the CBOE S&P 500 Covered Call Index, OTM and monthly-written.

7. XBW stands for S&P/ASX 200 Covered call index, the nearest OTM and quarterly written.
8. QQQ stands for Nasdaq 100 Exchange-Traded Fund.

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APPENDIX

Rebalancing Dates

Portfolio Rebalancing Dates					
04-Jan-00	30-Mar-00	29-Jun-00	28-Sep-00	21-Dec-00	29-Mar-01
28-Jun-01	27-Sep-01	20-Dec-01	27-Mar-02	27-Jun-02	26-Sep-02
19-Dec-02	27-Mar-03	26-Jun-03	25-Sep-03	18-Dec-03	25-Mar-04
24-Jun-04	23-Sep-04	23-Dec-04	23-Mar-05	23-Jun-05	29-Sep-05
22-Dec-05	30-Mar-06	29-Jun-06	28-Sep-06	21-Dec-06	29-Mar-07
28-Jun-07	27-Sep-07	20-Dec-07	27-Mar-08	26-Jun-08	25-Sep-08
18-Dec-08	26-Mar-09	25-Jun-09	24-Sep-09	17-Dec-09	25-Mar-10
24-Jun-10	23-Sep-10	23-Dec-10	24-Mar-11	23-Jun-11	29-Sep-11
22-Dec-11	29-Mar-12	28-Jun-12	27-Sep-12	20-Dec-12	27-Mar-13
27-Jun-13	26-Sep-13	19-Dec-13	27-Mar-14	26-Jun-14	25-Sep-14
18-Dec-14	26-Mar-15	25-Jun-15	24-Sep-15	17-Dec-15	

Calculation of EP and EPCC

S&P/ASX20 is formally rebalanced quarterly and so some stock components will be removed from the index, and some will be added to the index. Let $\Lambda(t)$ be the set of indices presenting the stocks appearing in S&P/ASX20 at the rebalancing period t. Assume that the initial investment amount is I. Then the value of the Equity Portfolio (EP) is initially V_0^{EP}=I. Let w_{it} be the weight of the i-th stock in $\Lambda(t)$. The investment amount on the i-th stock is the weight of the i-th stock times the total investment, i.e., $I_{w_{i,0}}$ for each $i \in \Lambda(0)$. At time 0, the number of stocks that we buy is

$$N_{i,0} = \frac{I_{w_{i,0}}}{P_{i,0}}$$

where $P_{i,0}$ is the stock price. The value of EP at time 1 before rebalancing the portfolio is the number of the stocks that we bought last quarter at the current price, namely

$$\tilde{V}_1^{EP} = \sum_{i\in\Lambda(0)} N_{i,0}P_{i,0}$$

Since the set of stocks appearing in S&P/ASX20 changes, in the first rebalancing period, we sell the stocks $i \in \Lambda(0)$, bought at the previous rebalancing period and buy a new set of stocks $j \in \Lambda(1)$. So, we buy the number

$$N_{j,1} = \frac{\tilde{V}_1^{EP} w_{j,1}}{P_{j,1}}$$

of stocks for each $j \in \Lambda(1)$. After rebalancing, the value of the EP at first period (at t=1) becomes

$$\mathrm{V}_1^{EP} = \sum_{i\in\Lambda(1)} N_{i,1}P_{i,1}$$

We repeat the same process at each rebalancing period. The value of the Equity Portfolio with CCS (EPCC) is calculated in a similar way by adding the option account to the equation. The value of EPCC at time 0 is the investment amount and agrees with the amount invested in the Equity Portfolio (EP),

$$V_0^{EPCC} = V_0^{EP} = I.$$

As mentioned previously, we assumed that the optioned rate is 25%. Hence the number of options to write at period t corresponding to the stock i is given by

$$N_{i,t}^{Op} = 0.25N_{i,t}$$

So, the value of EPCC at time t is the value of EP plus the value of the option account. This can be expressed as

$$V_t^{EPCC} = V_t^{EP} + \sum_{i\in\Lambda(\mathrm{t})} V_{i,t}^{Op}$$

Calculation of Option Account

As above, $N_{i,t}^{Op}$ denotes the number of options written of the stock i at time t and $P_{i,t}^{Op}$ the option settlement price. Then the option premium income at t is

$$V_{i,t}^{Premium} = N_{i,t}^{Op}\ P_{i,t}^{Op}$$

Let $V_{i,t}^{Op}$be the option account value corresponding to the i-th stock at time t and initially $V_{i,0}^{Op} = 0$. Option premiums written are subject to interest income between rebalancing dates. We do not add up option account cumulatively over time. Instead, in each rebalancing date, option account (including interest on the account from the previous period) at time $t - 1$ is incorporated into the portfolio account at time t. If the Option account is positive at time t-1, i.e.

$$V_{i,t-1}^{Op} > 0$$

then interest earning on $V_{i,t-1}^{Op}$ occurs for the period [t-1,t]. So, the interest income on the option account can be formulated as

$$V_{i,t}^{Interest} = r_{t-1}\mathbb{1}(V_{i,t-1}^{Op} > 0)V_{i,t-1}^{Op}$$

Here the interest rate r_{t-1} is the rate of Bank Accepted Bills over 90 days as in the previous rebalancing date, and

$$\mathbb{1}\left(V_{i,t-1}^{Op} > 0\right) = \begin{cases} 1 & if \;\; V_{i,t-1}^{Op} > 0 \\ 0 & otherwise \end{cases}$$

An option with expiry later than 5 days after the current rebalancing date had to be bought back. We refer to this expense as *Buy Back Expense*. The condition for the buyback can be given by

$$\mathbb{1}_{i,t-1}^{BuyBack} = \begin{cases} 1 & if \;\; T_{i,t-1} > t + 5d \\ 0 & otherwise \end{cases}$$

Here $T_{i,t-1}$is the expiry of the i-th option written at time t-1, and $t - 5d$ shows 5 days later than the current rebalancing date. If the i-th stock is subject to buy back, then we need buy the option for the i-th stock at time t with expiry and strike matching the written options. Hence the buyback expense is the number $N_{i,t-1}^{Op}$of options written on the i-th stock at time t-1 times the option price at time t with the same strike and expiry as the written option. the buyback expense at time t is given by

$$V_{i,t}^{BuyBack} = \mathbb{1}_{i,t-1}^{BuyBack} N_{i,t-1}^{Op} \, P_{i,t}^{Op}$$

If the option is not bought back at the current period and the stock price is bigger than the strike of the option, then the option is exercised. If there is a no buy back, then the exercise expense can be expressed as

$$V_{i,t}^{Exercise} = \mathbb{1}_{i,t-1}^{Exercise} N_{i,t-1}^{Op} (\, P_{i,t}^{Op} - K_{i,t-1})$$

Here $P_{i,t}$ is the stock price at time t, $K_{i,t-1}$is the exercise price of the written option at time t-1 and

$$\mathbb{1}_{i,t-1}^{Exercise} = \begin{cases} 1 & if \;\; P_{i,t} > K_{i,t-1} \\ 0 & otherwise \end{cases}$$

Namely, the option account,

$$V_{i,t}^{Op} = V_{i,t}^{Premiuim} + V_{i,t}^{Interest} - V_{i,t}^{BuyBack} - V_{i,t}^{Exercise}.$$

Calculation of International-Balanced Portfolio With and Without CCS

The International-balanced portfolio (IBP) is constructed from the daily data as in Table 1 with the weights shown in Figure 1. The returns and performance measures are calculated on a daily, monthly, quarterly, and yearly basis. Clearly, the value of IBP is the sum of the value of the portfolios.

$$V_t^{IBP} = V_t^{EP} + V_t^{InternationalStocks} + V_t^{FixedIncome} + V_t^{Property} + V_t^{Cash}.$$

Similarly, the value, V_t^{IBPCC} of the international-balanced portfolio with covered call strategies is obtained by replacing V_t^{EP} by V_t^{EPCC}.

Omega Ratio (Upside Potential/Downside Potential)

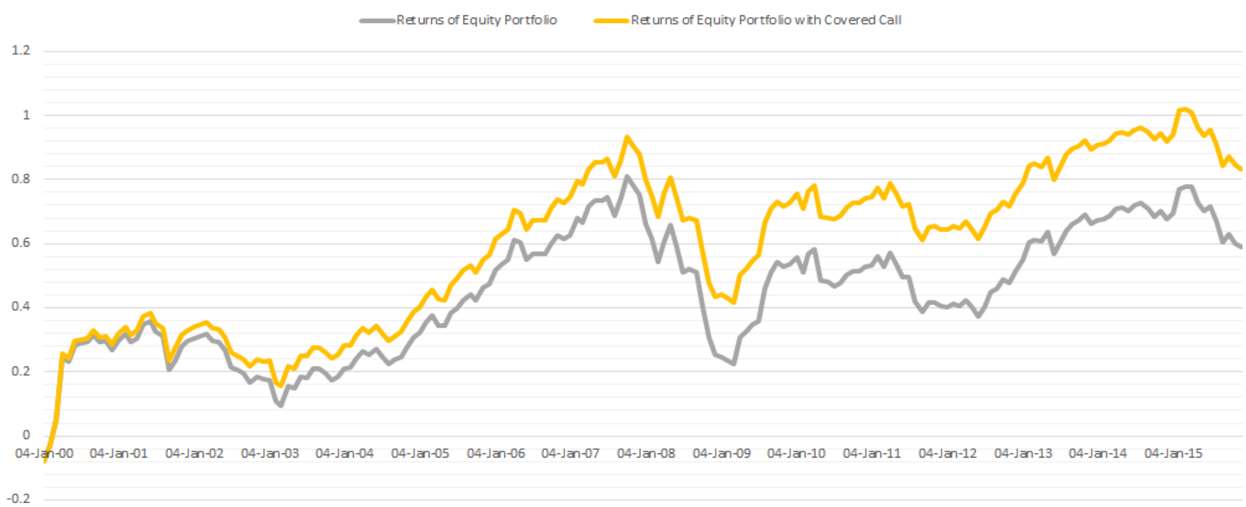
$$\Omega = \frac{\frac{1}{n}\sum_{i=1}^{n} max(r_i - r_T, 0)}{\frac{1}{n}\sum_{i=1}^{n} max(r_T - r_i, 0)}$$

Here r_T is the target return and is assumed to be the risk-free rate (see page 110 of Bacon (2013)).

More Graphs

We collected a few more figures and tables in this Appendix section to support our results.

FIGURE 11
MONTHLY CUMULATIVE RETURNS OF EPCC AND EP



The cumulative effect of CCS can be seen in Figure 12 over the entire 16-year period and Figure 13 over subperiods of length 4 years. Both figures also demonstrate the outperformance of EPCC.

FIGURE 12
QUARTERLY CUMULATIVE RETURNS OF EPCC AND EP UNDER BULL AND BEAR MARKET CONDITIONS

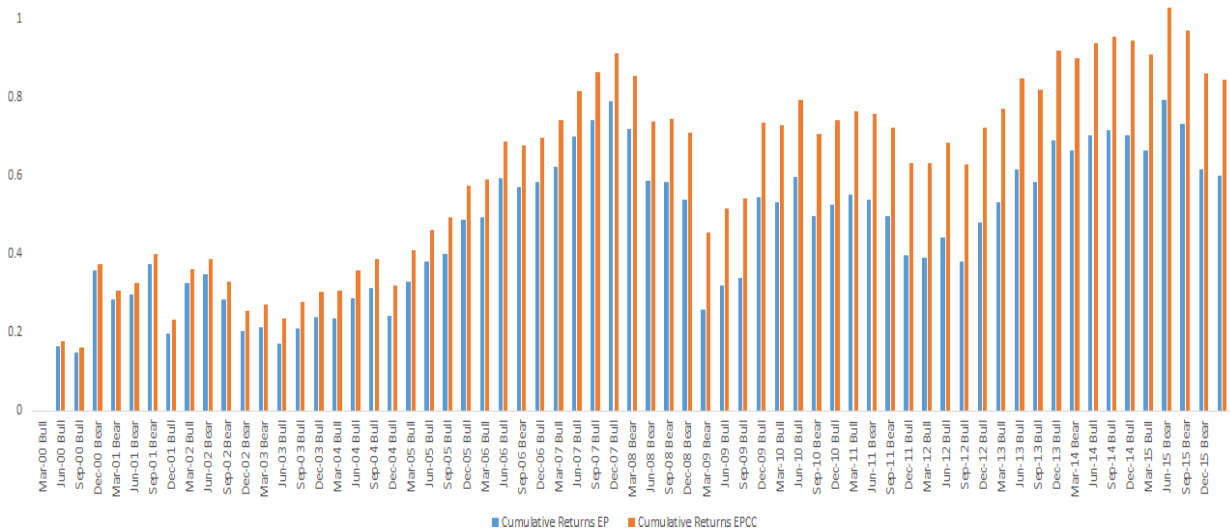


FIGURE 13
CUMULATIVE RETURNS OF EPCC AND EP OVER THE SUBPERIODS OF LENGTH 4 YEARS UNDER BULL AND BEAR MARKET CONDITIONS

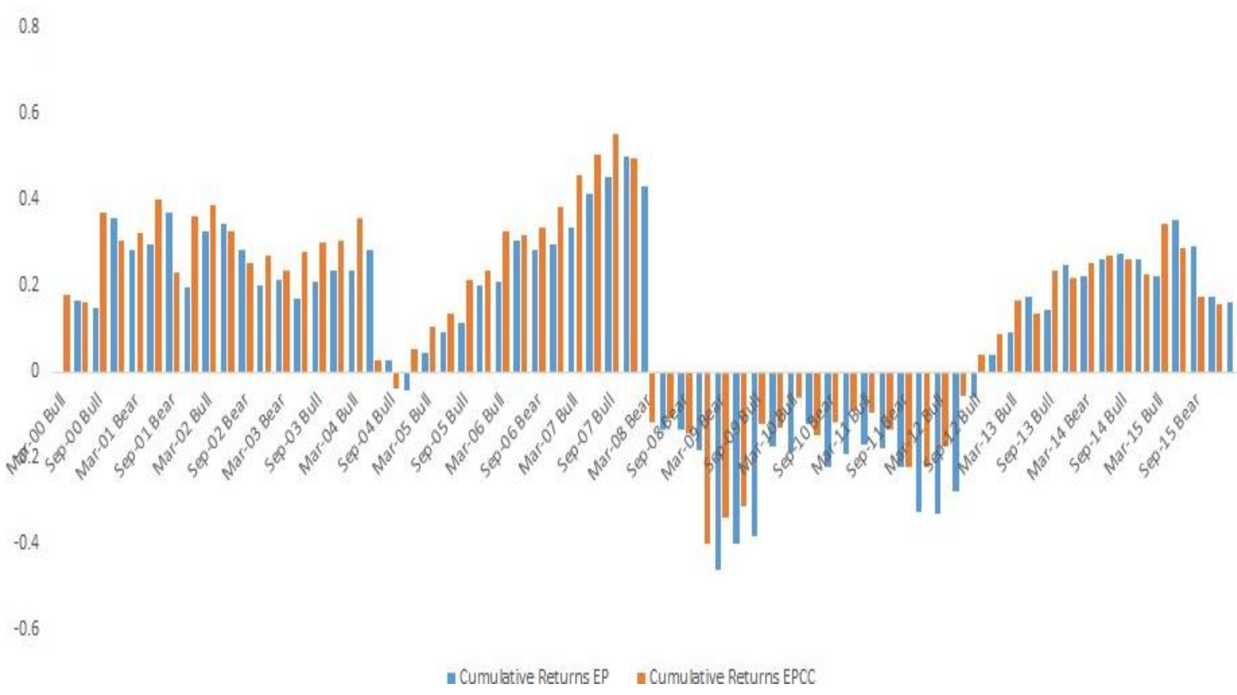


FIGURE 14
HISTOGRAM OF QUARTERLY RETURNS OF EPCC, EP, IBPCC AND IBP

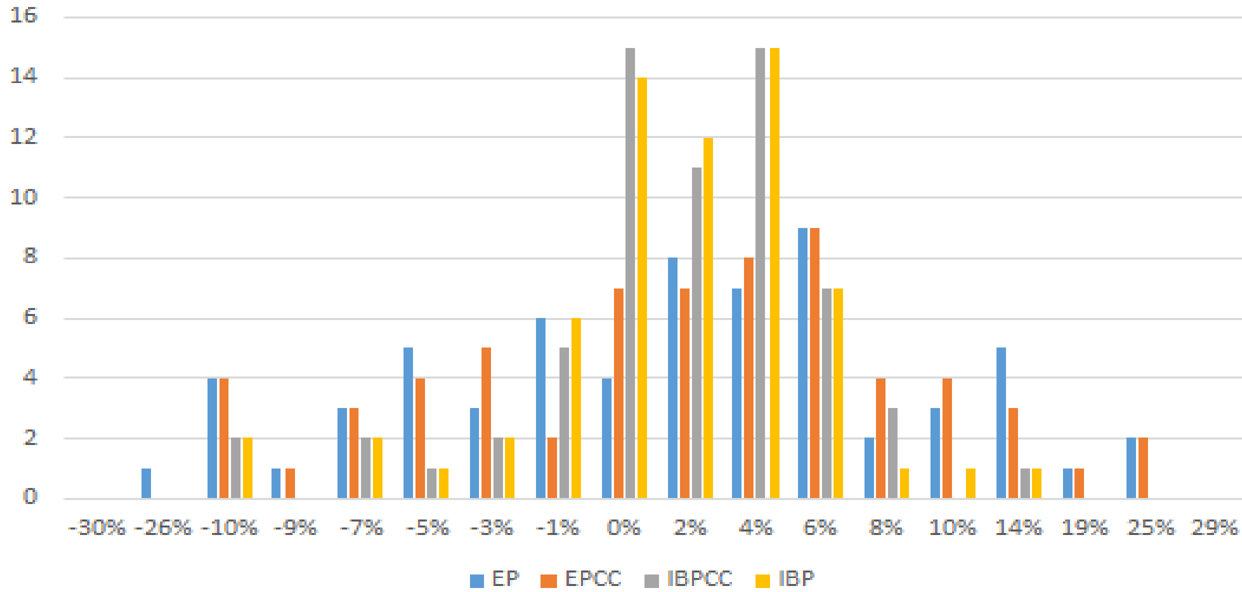


Figure 15 displays the differences between returns of EPCC and EP over the quarterly Bull and Bear periods.

FIGURE 15
THE RETURNS OF EPCC MINUS THE RETURNS OF EP UNDER BULL AND BEAR MARKET CONDITIONS

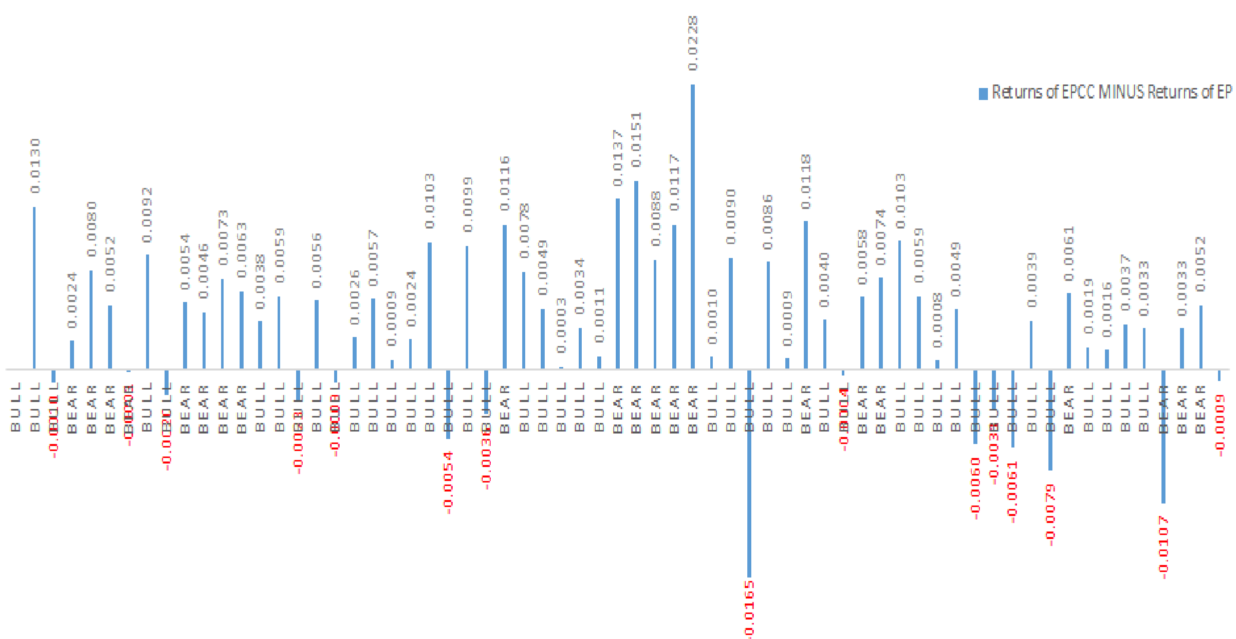


Figure 16 demonstrates the mean variance points of the portfolios that we studied in this paper.

FIGURE 16
MEAN AND VARIANCES OF PORTFOLIOS EPCC, EP, IBPCC AND IBP

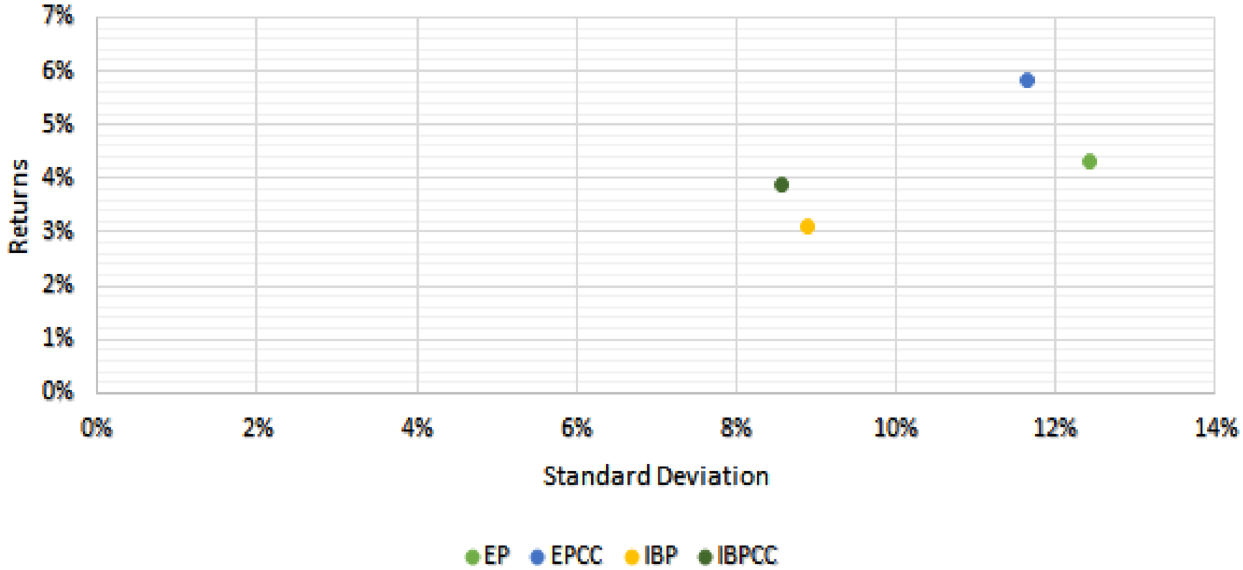


FIGURE 17
ADJUSTED SHARPE AND SORTINO RATIOS OF PORTFOLIOS EPCC, EP, IBPCC AND IBP (ANNUAL)