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FLIGHT OF THE CONDORS: EVIDENCE ON THE PERFORMANCE OF CONDOR OPTION SPREADS IN AUSTRALIA

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Abstract: This paper examined whether superior nominal and risk-adjusted returns could be generated using condor option spread strategies on a large capitalized Australian stock. Monthly Commonwealth Bank of Australia Ltd (CBA) condor option spreads were constructed from 2012 to 2015 and their returns established. Standard and alternative measures were used to determine the nominal and risk-adjusted performance of the spreads. The results show that the short put condor spread produced superior nominal and risk-adjusted returns, but seemingly underperformed when the upside potential ratio was taken into consideration. The long iron condor spread also offered reasonable returns across both performance metrics. On the other hand, the short call condor, long call condor, short iron condor and long put condor spreads did not perform as well on a nominal and risk-adjusted return basis. The results suggest that constructing spreads on the foundation of volatility preferences could be a driver of performance for condor option spreads strategies. For instance, short volatility condor spreads with negatively skewed return distribution shapes appear to add value, while long volatility condor spreads with positively skewed return distribution shapes seem to be less attractive over the sample period. Overall, condor option spreads demonstrate high risk-return profiles, offer versatility in their construction and intended pay-off outcomes, create value in some instances and can be executed across varying market conditions. It is suggested that risk averse investors best avoid condor option spreads, while those with above average risk tolerances may be well suited to the strategies, particularly short volatility-driven condor spreads.

Keywords: Condor; Options; Return; Risk; Spread; Volatility.

1. Introduction

Options are becoming increasingly popular with investors seeking alternative investments and greater versatility (McKeon, 2016). CME Group (2015) claim that the popularity of options in the US post-global financial crisis (GFC) period has grown from approximately 30 million contracts traded monthly in 2009 to 50 million in 2014. Option-based investment strategies have also seen solid growth over the last decade. For instance, US option-based equity funds have risen from 12 in 2003 to 119 in 2014, signifying almost a 900% increase and over $46 billion in assets under management (AUM) (Black and Szado, 2015).

Option spreads are an example of one of the many options-based strategies available to investors. Option spread strategies are considered by practitioners and sophisticated investors to be flexible investment vehicles, accounting for a growing proportion of the calls and puts traded in options markets (Chaput and Ederington, 2003; Falenbrach and Sandås, 2010; McKeon, 2016). For example, Chaput and Ederington (2003) reveal that option spread trading totals 29 per cent of Eurodollar option trading volume, while Falenbrach and Sandås (2010) show that vertical call and put option spread trading represents 16 per cent of FTSE 100 index option trading volume.

Essentially, option spreads are limited risk, directional or non-directional strategies that are constructed to generate a limited profit when volatility is expected to fall or rise (McKeon, 2016). Up to four legs are involved in most option spread strategies and a net debit/credit is outlaid/received for each position. The main benefit of option spread trading is that the strategies can be setup for anticipated market conditions over the intended holding period; thus, allowing investors to target investment goals that are tailored to their desired risk-return profiles (Niblock and Sinnewe, forthcoming). The pay-offs are also defined upfront, so while potential profits from the strategies are capped, so are the associated losses.

So do option spread strategies add value? And under what circumstances should the strategies be utilized? The international evidence is well established and generally appears to be supportive of option-based strategies (Chaput and Ederington, 2005, 2008; Hill et al, 2006; McKeon, 2016; Whaley, 2002). While numerous studies have empirically examined the performance of option-based strategies, only a few have been carried out in an Australian market setting, mainly focusing on covered call writing (El-Hassan et al, 2004; Frino and Wearin, 2004; Jarnecic, 2004; Mugwagwa et al, 2012; Niblock and Sinnewe, forthcoming; O'Connell and O'Grady, 2014).

Given the sparsity of evidence and their perceived benefits and costs, the performance of option spread strategies in Australia remains unclear, particularly those pertaining to 'condor' option spreads. Therefore, further empirical investigation is warranted. The aim of this paper is to examine the nominal and risk-adjusted return performance of Commonwealth Bank of Australia Ltd (CBA) monthly condor option spread strategies from 2012 to 2015. For comparative purposes, both standard and alternative performance measures are employed. The research question is:

'Do condor option spreads demonstrate superior nominal and risk-adjusted return outperformance in Australia?[1]

To address this question, two propositions are posed:

***P**$_1$: Superior nominal returns cannot be produced using CBA condor option spreads*

***P**$_2$: Superior risk-adjusted returns cannot be produced using CBA condor option spreads.*

The value of this study is that it is the first to empirically investigate the nominal and risk-adjusted return performance of condor option spreads in an Australian context. A comprehensive performance analysis of condor option spreads across various setups

[1] Condor option spreads are limited risk, non-directional strategies that are constructed using short-dated calls and/or puts to generate a limited profit when volatility is low or high.

will offer a better understanding of the role of option-based strategies in Australia, particularly on large capitalized and popular stocks like CBA. The results of this study will attempt to establish whether the strategies are a value-add for funds managers, traders and investors pursuing greater risk-return payoffs in the Australian stock market. They will also be of interest to those seeking alternative investments as a result of the limited availability of Australian retail financial products (Australian Treasury, 2014).

The main findings indicate that the short put condor spread produced superior nominal and risk-adjusted returns compared to the S&P/ASX 200 index, but seemingly underperformed when the upside potential ratio was taken into consideration. The long iron condor spread also offered reasonable returns across both performance metrics. Similar to McKeon (2016), these findings suggest that credit or 'short volatility' condor spreads appear to add value for investors seeking negatively skewed return distribution shapes. On the other hand, the short call condor, long call condor, short iron condor and long put condor spreads did not perform as well on a nominal and risk-adjusted return basis, particularly the debit or 'long volatility' condor spreads. The remainder of the paper is organized as follows. Section 2 highlights key literature. Section 3 describes the data and methods employed. Section 4 presents the empirical results. Section 5 discusses the implications of the results and proposes ideas for future research.

2. Literature Review

There remains a large amount of academic scrutiny and ongoing debate over whether option-based investment strategies generate superior performance (Mugwagwa et al, 2012). Some studies claim that covered call writing, for instance, demonstrates the potential to produce above average risk-adjusted returns (El-Hassan et al, 2004; Frino and Wearin, 2004; Hill et al, 2006; Jarnecic, 2004; Niblock and Sinnewe, forthcoming; O'Connell and O'Grady, 2014; Whaley, 2002). On the contrary, there is evidence to suggest that option-based strategies may actually weigh on investment returns and are inefficient methods of allocating wealth (Bookstaber and Clarke, 1984; Booth et al, 1985; Hoffmann and Fischer, 2012; Lhabitant, 1999; Merton et al, 1978; Mugwagwa et al, 2012). Hoffmann and Fischer (2012) maintain that option-based strategies can only be profitable in a mean-variance framework if the writer/taker can predict stock prices during the holding period (Reilly and Brown, 1997) and if call or puts are mispriced due to uncertainty associated with estimating volatility (Benninga and Blume, 1985; Black, 1975; Figlewski and Green, 1999; Hill et al, 2006; Leggio and Lien, 2002; Rendleman, 2001); thus, inferring market inefficiencies (Black and Scholes, 1972; Fama, 1998).

Given that option-based strategies have been found to exhibit asymmetric return distributions, a mean-variance analysis of their performances may not be appropriate (Bookstaber and Clarke, 1984; Booth et al, 1985; Lhabitant, 1999; Merton et al, 1978). For example, option spread trading shortens the positive/negative tail of the return distribution resulting in negative/positive skewness and decreases components of the variance; that is, upside/downside risk (Bookstaber and Clarke, 1984). Claims of outperformance based on the assumption that option returns produced from such strategies are normally distributed can therefore be misleading. This is particularly the case when variance is deemed to be a reliable measure of risk in asymmetric return distributions (Board et al, 2000; Leggio and Lien, 2002). Further, variance treats upside and downside risk symmetrically. As investors dislike investments with low returns and prefer investments with high returns, employing mean-variance performance measures (such as the Sharpe, Information and Jensen ratios) may lead to biased conclusions when assessing the non-linear payoffs of option spread strategies (Bernardo and Ledoit, 2000; Board et al, 2000; Groothaert and Thomas, 2003; Hübner, 2016; Mahdavi, 2004; O'Connell and O'Grady, 2014).[2]

Despite these issues, the academic literature pertaining to option spread trading is limited. This is surprising given the volume of literature on covered call writing and subsequent controversy surrounding the performance of option-based investment strategies. To the best of the author's knowledge, there are only a handful of empirical studies which address the performance of option spreads (see Chaput and Ederington, 2005, 2008; McKeon, 2016). Chaput and Ederington (2005, 2008) investigate Eurodollar option spread trades and find that they appear to reduce costs and/or increase profits associated with long out-of-the-money strike positions. McKeon (2016) examines bull call option spread trade setups using the S&P 500 index and finds that spreads held until maturity produce high average returns and negative/positive skewness in short/long volatility positions. McKeon further claims that short positions in out-of-the-money calls offer the strongest average returns, both before and after transaction costs.

3. Data and Methods

Closing prices, strikes and expiry dates for monthly Commonwealth Bank of Australia Ltd (CBA) call and put option series are sourced from the Thomson Reuters Tick History (TRTH) database. Monthly closing prices for CBA[3] and S&P/ASX 200 index data[4] are obtained from the S&P Capital IQ database. The investigation is restricted to CBA due to its size[5] and high positive correlation with the Australian stock market[6] (see Figure 1 below). CBA is also a highly liquid and sufficiently volatile stock (see Figure 2 below), thus presenting as a good proxy for the Australian stock market and an ideal candidate for condor option spread trading.

CBA condor option spreads are back-tested over a 36-month period from August 2012 to July 2015, with the sample period being determined by the availability of call and put option price data. Specifically, short-dated condor option spreads are executed at month-end expiration dates over CBA, with an expiry date in the following month. No early exercise is assumed and positions are kept open until expiration.[7] For margin purposes, it is assumed that shares in CBA or equivalent cash collateral are not held. As such, short call and put options are written naked, with ASX Clearinghouse margin requirements and transaction costs being ignored. To avoid any zero premiums on the CBA call and put series under investigation, the monthly option price is in some cases

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[2] Standard performance measures do not account for skewness and kurtosis and may overstate performance (Lhabitant, 2000; O'Connell and O'Grady, 2014).

[3] Monthly CBA closing prices are not adjusted for dividends and franking credits.

[4] The S&P/ASX 200 index is one of the largest capitalization-based indexes, covering approximately 80% of Australian stock market capitalization (Standard and Poors, 2017). Monthly ASX 200 index closing prices are not adjusted for dividends and franking credits.

[5] CBA is the largest company on the Australian stock market by capitalization (Standard and Poors, 2017).

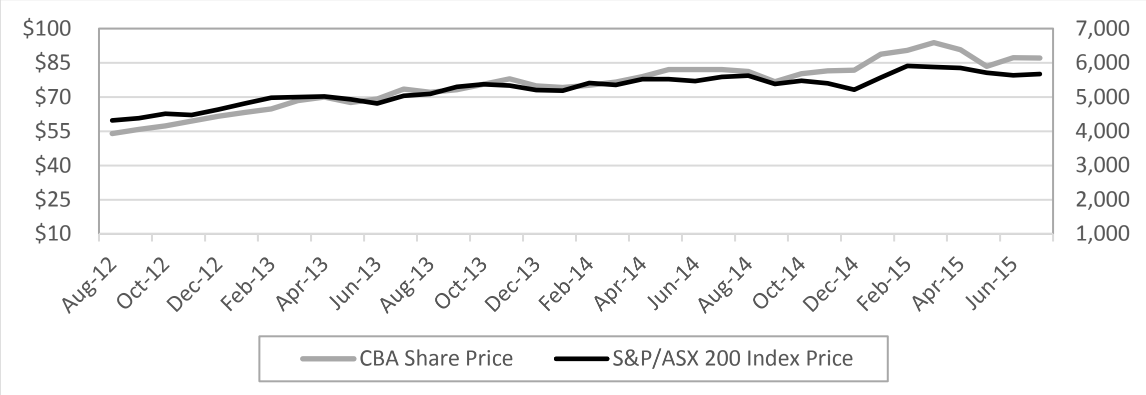
[6] CBA is highly positively correlated with the ASX 200 index; thus, CBA is considered a proxy for the Australian stock market in this study.

[7] Sometimes call and put options may be exercised before expiration. However, early exercise is mostly avoided due to time value associated with bought call and put options (Financial Times, 2015).

substituted by the settlement price. Where settlement prices are not available for the respective series, average monthly option prices over the sample period are employed.

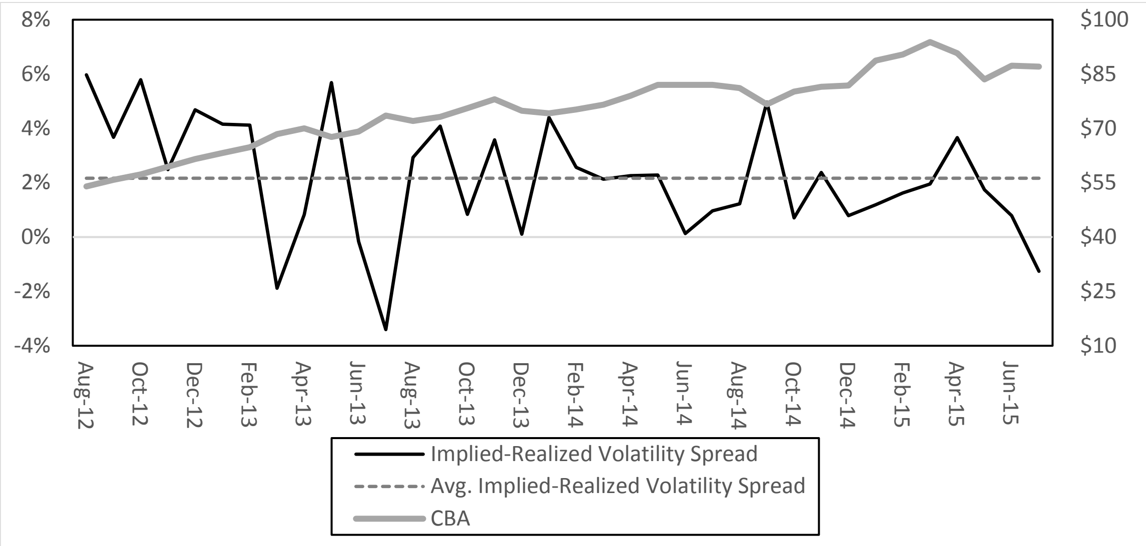
To estimate returns of the condor option spreads, CBA stock prices are established at month's t and t_{+1}.

Figure 1: CBA vs. S&P/ASX 200 price movement



Source: Capital IQ

Figure 2: CBA vs. S&P/ASX 200 volatility spread



Source: Capital IQ

CBA call and put option pricing data (i.e., option strikes and prices) are also identified at t with an expiry date in the following month t_{+1}.[8] CBA has multiple tradeable series in month t_{+1}, however, for the purpose of condor option spread trading in this study, it is assumed that t_{+1} call and put options with strike prices equivalent to the stock price at month t are traded one strike in-the-money (*1ITM*) and up to three strikes out-of-the-

[8] ASX expiry for individual equity options is the fourth Thursday of each calendar month (ASX, 2017).

money (*1OTM, 2OTM* and *3OTM*).[9] Note: each strike employed represents the relevant price increment for individual 'American' equity options series set by the ASX (ASX, 2017). In this study, CBA strike prices are in increments of one dollar.

Monthly component option returns of the CBA condor options spreads are established at *t* and are based on whether the respective call and put series are OTM or ITM at monthly expiry *t+1*. If a long call (LC) or long put (LP) is OTM at expiry, it is assumed that it expires worthless and the taker's loss is limited to the option premium paid, with no further obligation; thus, the OTM LC and LP returns for month *t* are calculated as:

$$R_{t(OTM\_LC,\ OTM\_LP)} = -1 \qquad (1)$$

If a LC or LP is ITM at expiry, exercise is assumed, the taker buys/sells shares from/to the call/put option writer at the nominated strike price and receives any price appreciation beyond the strike price; thus, the ITM LC and LP returns for month *t* under this scenario are calculated as:

$$R_{t(ITM\_LC)} = \frac{SP_{t+1} - STRK_t - OP_t}{OP_t} \qquad (2)$$

$$R_{t(ITM\_LP)} = \frac{STRK_t - SP_{t+1} - OP_t}{OP_t} \qquad (3)$$

where SP_{t+1}, $STRK_t$ and OP_t are the share price, strike price and option price at either *t+1* or *t*, respectively. If a short call (SC) or short put (SP) is OTM at expiry, it is assumed that it expires worthless and the writer keeps the option premium received upfront from the taker, with no further obligation; thus, the OTM SC and SP returns for month *t* are calculated as:

$$R_{t(OTM\_SC,\ OTM\_SP)} = \frac{OP_t}{STRK_t} \qquad (4)$$

where OP_t and $STRK_t$ are the option price and strike price at *t*, respectively. If a SC or SP is ITM at expiry, exercise is assumed, the call/put writer sells/buys shares to/from the option taker at the nominated strike price and is accountable for any price appreciation beyond the strike price; thus, the ITM SC and SP returns for month *t* under this scenario are calculated as:

$$R_{t(ITM\_SC)} = \frac{STRK_t - SP_{t+1} + OP_t}{STRK_t} \qquad (5)$$

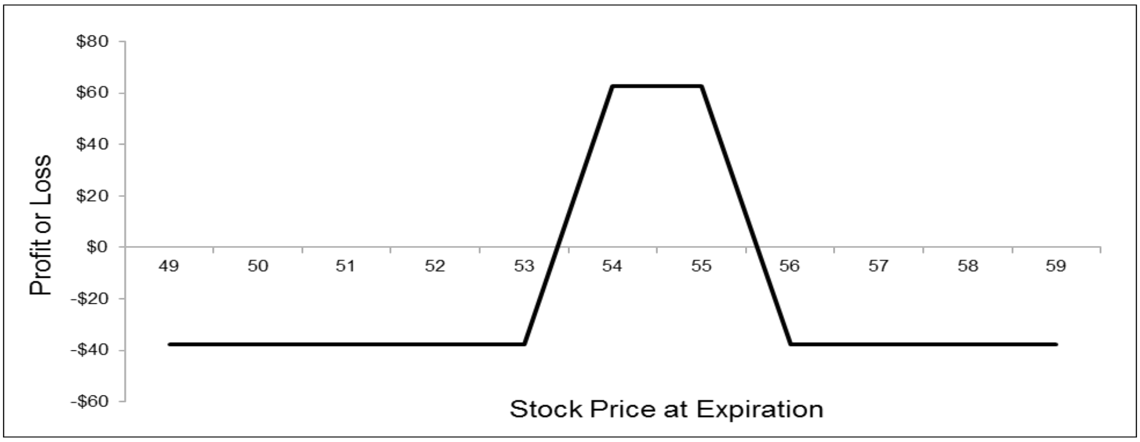
$$R_{t(ITM\_SP)} = \frac{SP_{t+1} - STRK_t + OP_t}{STRK_t} \qquad (6)$$

[9] Hill et al, (2006) claims that trading shorter maturity and closer to the money options offers adequate open interest and volume and greater volatility premium.

where $STRK_t$, SP_{t+1} and OP_t are the strike price, share price and option price at either *t* or *t+1*, respectively.

Once the component option returns are determined, the CBA condor option spreads can be constructed and their associated returns established. In this study, six condor option spreads are examined, namely the: 1) long call condor; 2) long put condor; 3) long iron condor; 4) short call condor; 5) short put condor; and 6) and short iron condor. Note: condor option spread positions are constructed depending on market conditions (e.g., low or high volatility) and intended trading directions to produce desired payoffs. Such payoffs can be diametrically different or identical, which highlights the versatility of the strategies (see Figures 3 and 4 below). The long call condor (LCC) and long put condor (LPC) spreads are limited risk, non-directional strategies that are constructed to generate a limited profit when volatility is low. Four legs are included in the respective strategies and a net debit is outlaid for each position. Using call or put options expiring in the same month, a LCC/LPC spread can be implemented by buying a *1ITM* call/put, selling a *1OTM* call/put, selling a *2OTM* call/put and buying a *3OTM* call/put (see Figure 3). Note: a LCC position can also be constructed by combining a bull call spread and a bear call spread; while a LPC position can be achieved by combining a bear put spread and bull put spread.

Figure 3: Long call/put and iron condor spread payoff

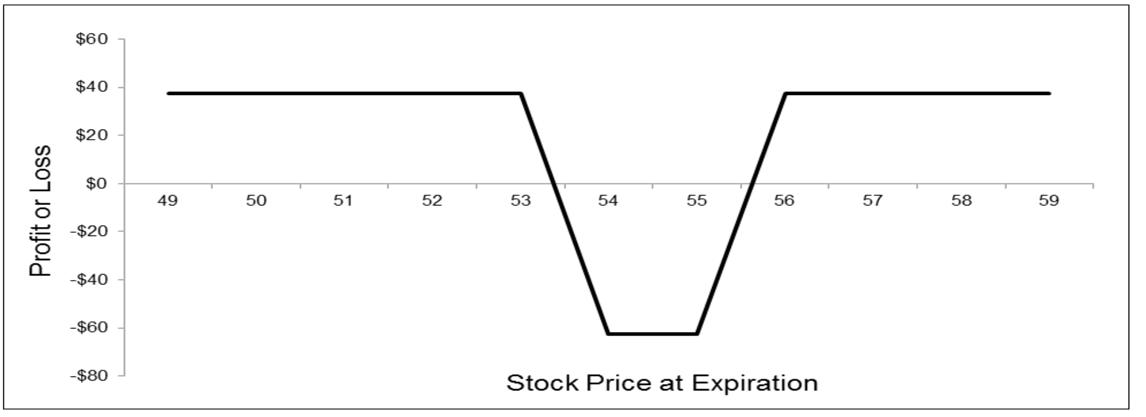


Source: Author

The long iron condor (LIC) spread is a limited risk, non-directional strategy that is constructed to generate a limited profit when volatility is high. Four legs are included and a net credit is received. Using call and put options expiring in the same month, a LIC spread can be implemented by selling a *1ITM* put, buying a *1OTM* put, selling a *2OTM* call and buying a *3OTM* call (see Figure 3 above). Note: a LIC position can also be achieved by combining a bull put spread and a bear call spread.

The short call condor (SCC) and short put condor (SPC) spreads are limited risk, non-directional strategies that are constructed to generate a limited profit when volatility is high. Four legs are included in the respective strategies and a net credit is received for each position. Using call or put options expiring in the same month, a SCC/SPC spread can be implemented by selling a *1ITM* call/put, buying a *1OTM* call/put, buying a *2OTM* call/put and selling a *3OTM* call/put (see Figure 4). Note: a SCC position can also be achieved by combining a bear call spread and a bull call spread; while a SPC position can be constructed by combining a bull put spread and bear put spread.

Figure 4: Short call/put and iron condor spread payoff



Source: Author

Finally, the short iron condor (SIC) strategy is a limited risk, non-directional strategy that is constructed to generate a limited profit when volatility is low. Four legs are included and a net debit is outlaid. Using call and put options expiring in the same month, a SIC spread can be implemented by buying a *1ITM* put, selling a 1*OTM* put, buying a *2OTM* call and selling a *3OTM* call (see Figure 4 above). Note: a SIC position can also be achieved by combining a bear put spread and a bull call spread.

The condor option spread returns at month *t* are calculated as:

$$R_{i,t(LCC)} = \frac{PROF_t(1ITM\_LC)+PROF_t(1OTM\_SC)+PROF_t(2OTM\_SC)+PROF_t(3OTM\_LC)}{STRK_t(1OTM\_SC)-STRK_t(1ITM\_LC)} \tag{7}$$

$$R_{i,t(LPC)} = \frac{PROF_t(1ITM\_LP)+PROF_t(1OTM\_SP)+PROF_t(2OTM\_SP)+PROF_t(3OTM\_LP)}{STRK_t(1ITM\_LP)-STRK_t(1OTM\_SP)} \tag{8}$$

$$R_{i,t(LIC)} = \frac{PROF_t(1ITM\_SP)+PROF_t(1OTM\_LP)+PROF_t(2OTM\_SC)+PROF_t(3OTM\_LC)}{STRK_t(1ITM\_SP)-STRK_t(1OTM\_LP)} \tag{9}$$

$$R_{i,t(SCC)} = \frac{PROF_t(1ITM\_SC)+PROF_t(1OTM\_LC)+PROF_t(2OTM\_LC)+PROF_t(3OTM\_SC)}{STRK_t(1OTM\_LC)-STRK_t(1ITM\_SC)} \tag{10}$$

$$R_{i,t(SPC)} = \frac{PROF_t(1ITM\_SP)+PROF_t(1OTM\_LP)+PROF_t(2OTM\_LP)+PROF_t(3OTM\_SP)}{STRK_t(1ITM\_SP)-STRK_t(1OTM\_LP)} \tag{11}$$

$$R_{i,t(SIC)} = \frac{PROF_t(1ITM\_LP)+PROF_t(1OTM\_SP)+PROF_t(2OTM\_LC)+PROF_t(3OTM\_SC)}{STRK_t(1ITM\_LP)-STRK_t(1OTM\_SP)} \tag{12}$$

where $R_{i,t}$ is the respective CBA condor option spread return; $PROF_t$ is the profit generated from the component call and/or put options (in dollars); and $STRK_t$ is the strike price of the component call or put options (in dollars).

To ensure that asymmetric return distributions associated with option-based strategies are accounted for, alternative 'non-linear' performance measures such as the Sortino ('downside risk') (Sortino and van der Meer, 1991) and upside potential ('upside risk')

(Sortino *et al*, 2003) ratios are utilized.[10] For comparative purposes, standard 'linear' performance measures such as the Sharpe (1966), Modigliani and Modigliani (1997) 'M²' (using both standard deviation (SD) and semi-standard deviation (SSD)) and Goodwin (1998) information ratios are employed. Consistent with the approach of Niblock and Sinnewe (forthcoming), a modified Jensen (1968) alpha model in ordinary least squares regression (OLS) form is also used. With this model, alpha (α_i) is designed to capture the excess risk-adjusted return of the condor option spread in relation to the ASX 200 index:

$$R_{i,t} - rf_t = \alpha_i + \beta_i (R_{m,t} - rf_t) + \varepsilon_{i,t} \tag{13}$$

where $R_{i,t}$ is previously defined; rf_t is the 30-day Australian bank accepted bill (BAB) return; and $R_{m,t}$ is the monthly ASX 200 index return. Note: *p*-values from the Newey-West *t*-statistics are adjusted for autocorrelation up to 3 lags using the Schwarz automatic observation-based lag selection approach. To address $\mathbf{P}_1$ and $\mathbf{P}_2$, summary statistics and standard and alternative performance measures are evaluated in an attempt to establish whether CBA condor option spreads deliver superior nominal and risk-adjusted returns versus the ASX 200 index.

4. Empirical Results

Summary statistics for the CBA condor option spreads are shown in Table 1, Panel's A and B. Note: LCC and SCC, LPC and SPC and SIC and LIC spread combinations are the inverse of each other, and as such, produce perfectly negative correlation coefficients (-1.000). Hence, only positive nominal returns associated with SCC, SPC and LIC are highlighted and subsequently discussed. In Panel A, the average monthly returns of the SCC, SPC and LIC spreads (1.28%, 12.18% and 6.46%, respectively) are higher than the ASX 200 (0.58%).[11] This infers that the 'credit' condor spreads performed better than the broader market and their 'debit' condor spread peers (e.g., LCC, LPC and SIC) on a nominal basis over the sample period. Further, the credit condor option spreads produced up to 21 times more return than the ASX 200 index, suggesting that the strategies provide large returns, but are also inherently risky. Notably, a t-test reveals that the average return for the SPC spread is positive and statistically significant at the 10% level. This indicates that the SPC spread significantly outperformed the ASX 200 index on a nominal return basis. All remaining t-tests were statistically insignificant. Based on these findings, $\mathbf{P}_1$ is rejected for the SPC condor option spread, with the remaining spreads accepting $\mathbf{P}_1$.

The condor option spreads demonstrate higher total and downside risk than the ASX 200 index. For instance, the standard deviations of the spreads range between 40.26% and 45.75% compared to 3.02% for the ASX 200, while the semi-standard deviations of the spreads range between 24.54% and 35.25% compared to 2.12%. The SCC spread has the highest standard deviation (45.75%) and the SPC spread the lowest (40.26%), which suggests that call-based condor spreads carry greater total risk than put-based and call

[10] It should be recognized that option-based strategies generally produce non-normal return distributions due to their asymmetric nature. Such asymmetry may undermine the use of traditional risk measures. For instance, the mean-variance framework treats upside and downside risk symmetrically, which can lead to erroneous conclusions when examining the performance of option-based strategies (McKeon, 2016; Mugwagwa et al, 2012; Niblock and Sinnewe, forthcoming; O'Connell and O'Grady, 2014). Thus, any evaluation of condor option spread performance should be treated with caution when using standard performance measures.

[11] Frequent exercise and unaccounted transaction costs associated with condor option spread trading may have influenced the return performances reported in this study.

and put-based condor spread combinations. On the other hand, the SCC spread has the highest semi-standard deviation (35.25%) and the LIC spread the lowest (24.54%). With the exception of LIC, credit condor spreads appear to produce greater downside risk than their debit spread counterparts (e.g., LCC, LPC and SIC). Further, condor option spreads generate up to 15 times more total risk and up to 17 times more downside risk than the ASX 200 index.

Table 1: Summary statistics

Significance level: * 10%; ** 5%; *** 1%. SCC is short call condor. SPC is short put condor. LIC is long iron condor. ASX200 is S&P ASX 200 index. Full results are available from author upon request.

Panel A - Descriptives

	SCC	SPC	LIC	ASX200
Mean	1.28%	12.18%	6.46%	0.58%
T-stat.	0.0912	1.7237*	0.8496	NA
Median	21.50%	21.00%	-6.25%	0.36%
Max.	81.00%	116.00%	100.50%	6.88%
Min.	-88.50%	-94.00%	-44.00%	-7.69%
Std. Dev.	45.75%	40.26%	41.40%	3.02%
Semi-Std. Dev.	35.25%	32.45%	24.54%	2.12%
Excess St. Dev.	46.46%	40.21%	41.02%	NA
Skewness	-0.5104	-0.8154	0.7134	-0.1884
Kurtosis	2.1690	4.4106	2.1636	3.2922
Jarque-Bera	2.5990	6.9735**	4.1028	0.3411
Obs.	36	36	36	36

Panel B – Correlation coefficients

	SCC	SPC	LIC	ASX200
SCC	1.0000			
SPC	-0.1879	1.0000		
LIC	-0.8416***	0.3622**	1.0000	
ASX200	-0.2060	0.0537	0.1596	1.0000

Condor option spread return distributions are also more skewed than the ASX 200 (-0.1884). For example, the LIC spread is positively skewed (0.7134), while the SCC and SPC spreads are negatively skewed (-0.5104 and -0.8154, respectively). The ASX 200 index return distribution produces a relatively normal tail (3.2922). Conversely, the SPC spread is more heavy-tailed (4.4106), while the LIC and SCC spreads are more light-tailed (2.1636 and 2.1690, respectively). Non-normal return distributions are particularly evident in the SPC spread (6.9735), with the reported Jarque-Bera test statistics being significant at the 5% level. In Panel B, the correlation measures for the pairwise condor option spread combinations are presented. The LIC spread is correlated with the SCC (-0.8416) and SPC (0.3622) spreads, and are statistically significant at the 5% level or better. All remaining spread combinations are statistically insignificant. The statistically significant correlations discovered suggest that synthetic condor option spread positions may be constructed depending on market conditions and intended trading directions, which again highlights the versatility of the strategies.

Risk-adjusted performance measures for the CBA condor option spreads are presented in Table 2. Note: LCC is the counterparty of SCC, LPC is the counterparty of SPC and SIC is the counterparty of LIC. Again, similar to the summary statistics, only positive risk-adjusted returns associated with SCC, SPC and LIC are highlighted and subsequently discussed. With the exception of the SPC and LIC spreads, the Sharpe and M^2 (SD) ratios show that condor spreads are more exposed to total risk and produce lower risk-adjusted returns than the ASX 200 index. For instance, using the Sharpe ratio, the SCC (0.0230) spread underperformed the ASX 200 (0.1177), while the SPC (0.2969) and LIC (0.1506) spreads outperformed. To explain in percentage terms, the M^2 (SD) ratio indicates that on a risk-adjusted return basis the SPC spread outperformed the ASX 200 index by 0.54% monthly. The information ratios reveal that condor spreads have mixed excess volatility and risk-adjusted return performance when compared to the ASX 200 index. For instance, the information ratios for the SCC (0.0150), SPC (0.2884) and LIC (0.1433) spreads outperformed the ASX 200.

Table 2: Risk-adjusted performance measures

Significance level: * 10%; ** 5%; *** 1%. *p*-values from the Newey-West *t*-statistics are adjusted for autocorrelation up to 3 lags using the Schwarz automatic observation-based lag selection approach. SD is standard deviation. SSD is semi-standard deviation. Full results are available from author upon request.

	SCC	SPC	LIC	ASX200
Sharpe Ratio	0.0230	0.2969	0.1506	0.1177
M^2 Ratio (SD)	-0.29%	0.54%	0.10%	NA
Information Ratio	0.0150	0.2884	0.1433	NA
Jensen Alpha	0.0216	0.1171	0.0546	NA
T-stat.	0.2861	1.8076*	0.7875	NA
Sortino Ratio	0.0298	0.3684	0.2540	0.1679
M^2 Ratio (SSD)	-0.29%	0.42%	0.18%	NA
Upside Potential Ratio	0.5534	0.4148	0.7143	0.5565

Further, the modified Jensen alphas demonstrate that condor option spreads (with the exception of the SPC spread) do *not* generate higher risk-adjusted returns than the ASX 200 index. After adjusting for systematic risk, the SCC (0.0216), SPC (0.1171) and LIC (0.0546) spreads produced positive alphas. The SPC spread delivered the greatest outperformance versus the ASX 200, being statistically significant at the 10% level.

Standard 'linear' performance measures can be problematic when considering the risk-adjusted return performance of condor option spreads however. This is due to the asymmetric nature of the strategies and the use of standard deviation as the nominated risk measure, but can be alleviated by the use of downside and upside risk performance measures such as the Sortino and M^2 (SSD) and upside potential ratios, respectively (El-Hassan *et al*, 2004; Niblock and Sinnewe, forthcoming). With the exception of the SPC and LIC spreads, the Sortino and M^2 (SSD) ratios show that condor spreads have a greater exposure to downside risk and generate lower risk-adjusted returns than the ASX 200 index. For example, using the Sortino ratio, the SCC spread (0.0298) underperformed the ASX 200 (0.1679), while the SPC (0.3684) and LIC (0.2540) spreads outperformed.

Of the condor spreads, the SPC spread had the highest Sortino ratio. In percentage terms, the M^2 (*SSD*) ratio indicates that on a risk-adjusted return basis the SPC spread outperformed the ASX 200 index by 0.42% monthly. On the other hand, the upside potential ratios revealed that condor option spreads have mixed upside risk-adjusted return performance. For example, the upside potential ratios for the LIC spread (0.7143) outperformed the ASX 200 (0.5565), while the SCC (0.5534) and SPC (0.4148) spreads underperformed. Again, based on the weight of evidence presented, $\mathbf{P}_2$ is rejected for the SPC condor option spread, with the remaining spreads accepting $\mathbf{P}_2$.

5. Conclusion

This paper investigated whether superior nominal and risk-adjusted returns could be generated using monthly condor option spread strategies on a large capitalized Australian stock (i.e., Commonwealth Bank of Australia Ltd (CBA)) from 2012 to 2015. The results of this study are mostly consistent with the limited empirical option spread performance studies conducted to-date (see Chaput and Ederington, 2005, 2008; McKeon, 2016). Specifically, the findings indicate that the SPC spread produced superior nominal and risk-adjusted returns compared to the ASX 200 index, but seemingly underperformed when the upside potential ratio was taken into consideration. The LIC spread also offered reasonable returns across both performance metrics. Similar to McKeon (2016), these findings suggest that credit or ‘short volatility’ condor spreads appear to add value for investors seeking negatively skewed return distribution shapes.

On the other hand, the SCC, LCC, SIC and LPC spreads did not perform as well on a nominal and risk-adjusted return basis, particularly the debit or ‘long volatility’ condor spreads (e.g., LCC, SIC and LPC). Therefore, constructing spreads on the basis of short or long volatility preferences could be a driver of performance for condor option spreads strategies. For instance, writing/buying calls and/or puts during periods of heightened market volatility may be particularly advantageous/disadvantageous for credit/debit condor spreads (McKeon, 2016; Niblock and Sinnewe, forthcoming). Outperformance/underperformance of the market (e.g., ASX 200 index) could also be explained by the potential overpricing of written/bought call and/or puts options during such periods (Figelman, 2008; Hill et al, 2006; Kapadia and Szado, 2007; McIntyre and Jackson, 2007; O’Connell and O’Grady, 2014; Simon, 2011, 2013).

Overall, the evidence presented suggests that with the exception of the SPC spread, condor option spread strategies do not produce superior nominal or risk-adjusted returns. They do however, demonstrate high risk-return profiles, offer versatility in their construction and intended pay-off outcomes, create value for investors in some instances (i.e., SPC) and can be executed across varying market conditions. For example, the SPC spread strategy is particularly useful for investors seeking speculative positions in upward trending price and/or volatile market environments. Moreover, converting uncertain future capital gains into immediate cash flows appears to be advantageous for investors pursuing short volatility positions. It is therefore suggested that risk averse investors best avoid condor option spreads, while those with above average risk tolerances may be well suited to the strategies, particularly short volatility-driven condor spreads.

The value of this study is that it is the first to empirically examine the nominal and risk-adjusted return performance of condor option spreads in Australia. The results are useful for funds managers, traders, investors and academics evaluating the performance of condor option spread strategies. The research also builds on the work of McKeon (2016), who shows that short volatility call option spread trades on S&P 500 index options held until maturity produce high average returns and strong negative skewness, both before and after transaction costs. Further, the study adds to our understanding of the performance of condor option spreads by supporting findings in the Australian options literature (see Niblock and Sinnewe, forthcoming). For example, credit condor spreads have the potential to generate superior nominal and risk-adjusted returns over the ASX 200 index, which could be attributable to the overpricing of call and put options in Australia.

It should be borne in mind however, that the results only captured market conditions/settings specific to the stock chosen (e.g., CBA), option spread employed (e.g., condor) and holding period under investigation (e.g., monthly data from 2012 - 2015). The performances reported could be attributable to market/asset location and direction and volatility and liquidity factors. Costs associated with frequent trading and exercise were also not accounted for. Thus, the findings should be treated with caution, as they do not represent all potential risk-return characteristics and pay-offs pertaining to option spread trading in the Australian market (El-Hassan et al, 2004; Niblock and Sinnewe, forthcoming).

To overcome these limitations, future research could replicate the approach adopted in this study but across different Australian markets/sectors/companies, time periods, data intervals, option spreads (e.g., butterfly, calendar, condor, diagonal and/or vertical spreads) and option moneyness. Researchers exploring option spread performance are also encouraged to consider option market liquidity, volatility and transaction costs under this setting (Hill et al, 2006; McKeon, 2016). It is anticipated that such research will expand the literature on this interesting and under-researched topic by providing a better understanding of option spread trading in Australia. The further development of option strategies that attempt to mitigate risk and enhance returns are clearly desirable outcomes for modern investors.

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