Applying The Put-Call Parity

Gregory Giordano, Dr. George Calhoun, and SMB Capital

Stevens Institute of Technology
The Innovation University

Pinnacle Scholars Summer Research Program 2019

Introduction

- Utilizing the Put-Call Parity is a heavily talked about subject in Finance
- Finding real opportunities to apply the Put-Call Parity to make a profit is rare

Objective: Create a model to analyze actual applications of the Put-Call Parity using live data

Put-Call Parity

Background:

$$C + Ke^{-rT} = S + P$$

- **C : The current cost of a call option**
- **K : The strike price of both the call and put option**
- **r : The risk-free rate (LIBOR)**
- **T : The time until expiration of the options**
- **S : The current stock price**
- **P: The current cost of a put option**

Theory of Put-Call Parity:

The theory behind the Put-Call Parity depends on the assumption you have a stock that does not pay a dividend, a call and put with the same strike price and expiration date, and access to borrow at/invest at the risk-free rate (LIBOR). The parity is derived by considering two portfolios (A and C):

A. A call option plus a zero-coupon bond that provides a payoff of the strike price at time T

C. A put option plus one share of the stock

In portfolio A, if the stock price S at time T is above the strike, then the portfolio is worth (S – K) + K = S at time T. If S is less than K, then the portfolio will only be worth K at T because the call will expire worthless.

In portfolio C, if the stock is below the strike at T, then the portfolio will be worth (K-S) + S = K. If S is greater than K, then the put option in portfolio C will be worthless and the portfolio will be worth S.

Therefore, the two portfolios are theoretically equivalent in value.

Table 11.2 Values of Portfolio A and Portfolio C at time T.

		$S_T > K$	$S_T < K$
Portfolio A	Call option	$S_T - K$	0
	Zero-coupon bond	K	K
	Total	S_T	K
Portfolio C	Put Option	0	$K - S_T$
	Share	S_T	S_T
	Total	S_T	K

Application of Put-Call Parity

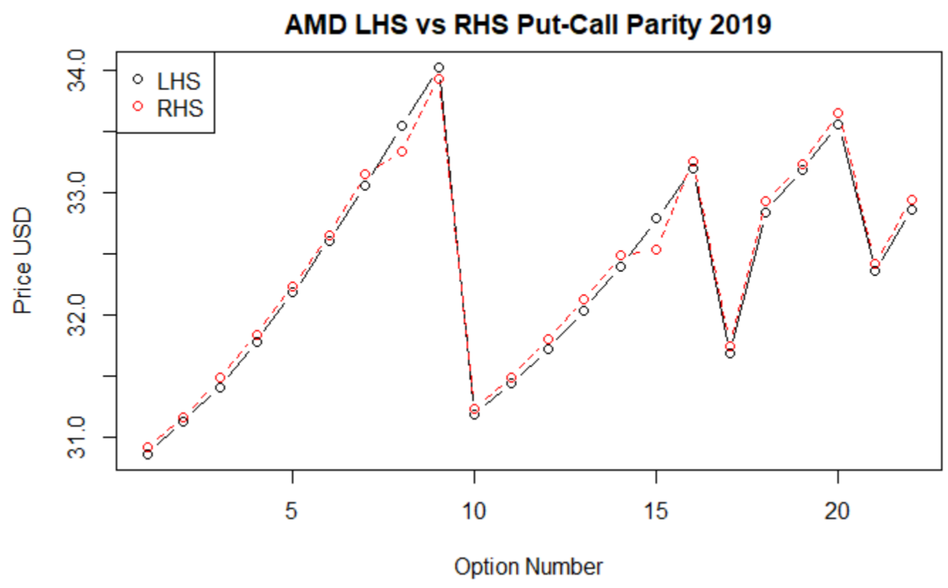
Data Collection and Strategy:

Data Collection

To apply the Put-Call Parity in the live market, we utilized R for both gathering data and trading strategies. To gather data, we used the R libraries Quantmod and Rvest. Quantmod enabled access to option chains from Yahoo Finance and Rvest enabled us to implement a web-scraping algorithm to gather live-stock and LIBOR data. We chose 15 non-dividend paying stocks in the S&P 500 to run our strategy.

Strategy

We chose to deal only with options expiring in 2019 due to uncertainty regarding the future market environment. Since the left-hand side (LHS) of the Put-Call Parity should be equivalent to the right-hand side (RHS), if the LHS was less than the RHS, we tested a strategy that would long a call option, short the stock and put option and invest the proceeds at the risk-free rate. If the RHS was less than the LHS, then we tested the results of longing the stock and put option by borrowing at the risk-free rate and shorting the call option. *To provide context of how the LHS and RHS model each other and where opportunities for arbitrage (risk-free profit) arise, below is a graph of testing AMD's LHS and RHS values. Arbitrage is available when the lines diverge*



Analysis for Retail Traders with TD Ameritrade

While arbitrage opportunities are virtually impossible for retail traders to obtain, using TD Ameritrade's commission costs as a baseline, we can see how the application of the Put-Call Parity could work.

Stock Commission <fctr>	Option Commission <fctr>	Fixed Income Commission <fctr>
6.95	6.95 + .75/contract	No Cost

Since commissions are $6.95 for each trade, on a typical application of the strategy, a trader would have to pay $41.70. Also, finding a way to be able to easily borrow and invest at LIBOR over the wanted time periods is very difficult.

Results

Mean Correlation <dbl>	Mean Profit <dbl>	Transaction Cost <dbl>
0.9901427	0.752414	41.7

After building an R script to sort through the data of the non-dividend paying stocks, we see the average correlation between the LHS and RHS of the Put-Call Parity was .9901427. While the correlation is very close to 1, the slight discrepancy enables traders to capture an opportunity. On average, while using 1 stock share, 1 call option, and 1 put option, a trader could possibly make $0.752 from the strategy. Thus, the $0.752 could be scaled by increasing quantity and ultimately leading to a profit. The future research will have to discuss the plausibility of a retail trader in capturing the opportunity with necessary executions.