Research on the Valuation of Chooser Options: Case of AAPL

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Abstract. The financial market is becoming increasingly sophisticated as the economy grows. Since the majority of investors are looking for the best investment to decrease risks and increase returns, the flexibility that chooser options offer is very appealing. This article provides a detailed analysis of the chooser options, emphasizing their significance and usefulness in financial markets. Since determining the precise value of options is relatively challenging, the essay involves both the qualitative and quantitative aspects of pricing chooser options, which implies a wide variety of applications in various market circumstances. Explanations in this article focus on how chooser options are applied in practice, including options' essential properties, exotic options' role in the financial markets, introduction to chooser options, and the valuation process. By using Monte-Carlo simulation, the paper investigates variables influencing the value of AAPL's chooser options. It aids in explaining how uncertainty and risks affect predicting and forecasting models by estimating the potential outcomes of an uncertain event. According to the calculations used in this article, Apple Inc.'s (AAPL) price is tightly connected with the selected period and less correlated with volatility and its strike price at one-year maturity. With chooser options, the investor has the discretion of deciding in advance if the option is a put or a call. In this way, this article contributes to the comprehension of investing choices.

Keywords: exotic option, chooser option, valuation, interest rate, stock price

1. Introduction

Due to the financial market's rapid development, new and effective financial instruments - contractual arrangements for the construction, creation, modification, or settlement of monetary assets—have been introduced. Everyone involved in the financial markets must respond quickly to market developments and make any necessary adjustments to the investment strategy because the amount of investment risk is rising at the same time. Investors are therefore seeking fresh investment opportunities that might produce income from the investment and adapt to changing market conditions.

There are contractual responsibilities between the two parties involved in a financial instrument transaction. The underlying assets used to value the derivative instruments include raw commodities, cash, bonds, stocks, and stock indexes. Another illustration of a derivatives instrument is an option, which is a contract between the parties in which the seller provides the right rather than the duty to purchase or sell a number of derivatives for a defined price over a certain period of time. An extensive range of option strategies for hedging, earning an income, or speculating is built on call options and put options. Put options enable the holder to sell the asset at a given price and time, whilst call options allow the investor to buy the asset at a specific price and time. For investors, they need to carefully think about the risks even if there are numerous opportunities to gain profit through options.

Derivatives could help investors to offer a means of performing fixed prices, hedging against adverse rate changes, and reducing risks. Exchange-listed options were traded for the first time in 1973 [1]. Since then, their global trade volumes have increased dramatically. The features and characteristics options offer are dedicated to this evolution and development. Much previous research in financial literature has provided examples of how options may be employed in a variety of contexts to provide a range of investment opportunities [2-4]. Though standard forms are regularly traded, new types of options emerge and grow in scale, enabling investors to hedge their investment portfolios and have access to a wide range of complicated products. Exotic option markets have grown in scale in well-established financial markets during the past ten years. As a result, investors have access to a

wide range of complicated products. A general term for derivative products with more intricate trading on an exchange arrangements than regular options is exotic options. Exotics are often sold to sophisticated institutional investors or hedge funds and traded over the counter [5,6]. They are incredibly adaptable and may be tailored to any investor's unique requirements, providing a significant hedging function that efficiently satisfies the demands of hedgers. In addition, exotic choices often cost less and use less energy than conventional instruments. As a result, exotic options may be utilized to make profitable trades and investments. Theoretically, if the call option holder chooses to execute the right to purchase, the writer of call option is supposedly required to trade the commodity. Put options enable the holder to sell a predetermined amount of the underlying assets at the market price no later than the expiry deadline. If the put option holder selects to invoke the rights of selling, the writer of put options is required to consider buying the underlying asset at the strike price.

This paper delivers a comprehensive analysis of chooser options, with a detailed overview and how they are used in practice. Besides, it also evaluates the differences between a straddle strategy and a chooser option which focuses on the price advantage of the exotic contract. A pricing model in Excel using Monte Carlo simulation is built. Moreover, for the sample pricing, the stock of Apple was chosen, collecting historical data for other parameter estimation. The model was then subjected to a sensitivity analysis to see how changes in the model's basic parameters would affect the premium.

2. Company Profile

2.1 Firm Description

Apple Inc. is a multinational technological corporation with a focus on hardware, software, and online services. The company then built Apple II, one of the first microcomputers to be mass-produced, which gained popularity very rapidly. Apple went public in 1980 and saw rapid financial success [7]. In particular, Apple Inc. (Apple) creates, manufactures, and sells accessories, wearable technologies, and mobile devices including smartphones and tablets. In addition, it provides a variety of related services. A wide range of products are available from the corporation. The results of the Retail segment are excluded from the geography-based segments. Apple faces a number of dangers while dominating the market, including altering market environment, shifting customers' needs, international competition, and probable supply disruptions. Apple employs roughly 35,000 people globally, as of September 29, 2008, it had global sales of US$32.48 billion.

2.1.1 Financial Analysis

Statistical information is made available by AAPL Nasdaq and includes valuation metrics, trade data, accomplishments for the fiscal year, profitability, management effectiveness, financial statements, balance sheet, and cash flow statement, among other things. The data helps investors earn a comprehensive understanding of APPL's financial performance.

2.1.1.1 Stock Price History

As shown in table 1, the most current long-term forecast is that the price of an Apple product would reach $200 by the end of 2024 and $250 by the middle of 2026. The stock price of Apple will hit $300 in 2027 and $400 in 2032. In 2022, Apple's prices started at $177.57. At $150.43, Apple is presently down 15% from where it was at the start of the year. The estimated price of an Apple product by the end of 2022 is $152, down -14% from the previous year. From now until the end of the year, the rise will be 1%. The price of Apple will increase by $24 in the second half of 2023 to $189, which is a +26% increase over the current price. The price will climb to $165 in the first half of 2023 [10].

Table 1. Historical Stock Price Analysis 9]

Beta (5Y Monthly)	1.23
52-week Change	3.48%
S&P500 52-week Change	-16.88%
52 Week High	182.94
52 Week Low	129.04
50-Day Moving Average	160.21
200-Day Moving Average	160.59

2.1.1.2 Major Holders Summary

Stockholders own Apple since it is a publicly listed company. In accordance with Yahoo Finance, Apple has more over 16 billion shares outstanding as of March 2022 (table 2). Apple's stock is largely owned by companies. As of February 2021, the Vanguard Group had more than 1.3 billion shares, or 7.83% of Apple's outstanding stock, making it the company's largest institutional shareholder, according to Investopedia. 1.11 billion shares, or 6.60% of the outstanding stock, were held by BlackRock. Nearly 6% of all outstanding shares were owned by Berkshire Hathaway, who had more over a billion shares. Insiders who work for Apple, including those in leadership positions and on the board of directors, also hold significant shares in the company. According to Investopedia, CEO Tim Cook had over 800,000 shares as of December 2020, and Jeff Williams, the COO of Apple, held close to 500,000 shares, while more than 4.5 million shares were controlled by the chairman, Arthur Levinson.

Table 2. Share Statistics

Avg Vol (3 month)	75.66M
Avg Vol (10 day)	104.17M
Shares Outstanding	16.07B
Float	16.05B

Table 3. Major Holders Breakdown

% of Shares Held by All Insider	0.07%
% of Shares Held by Institutions	59.75%
% of Float Held by Institutions	59.79%
Number of Institutions Holding Shares	5498

2.1.1.3 Firm Portfolio

As listed in table 4, the future annual dividend yield for AAPL was 0.61%, and the ahead annual dividend rate was 0.92, according to Nasdaq. The five-year average dividend yield was 1.03, the trailing annual dividend yield was 0.58%, and the trailing annual dividend rate was 0.89.

Table 4. Market Activity Summary

Day's Range	148.56 - 151.47
52 Week Range	129.04 - 182.94
Volume	96,029,909
Avg. Volume	75,663,236
Market Cap	2.418T
Forward Dividend & Yield	0.92 (0.61%)
1y Target Est	182.01

3. Conceptual Features of Chooser Options

Chooser options are contracts in the financial industry that allows the holder to choose between taking a put and a call option. Prior to the expiration date, this is routinely done. No matter whatever

option the owner of the stock chooses, every chooser option has a set expiry date and striking price. When the underlying asset's value increases gradually, the call option would be chosen by the holder since it will be more valuable than the put option. The put option will be the default when the underlying asset increases in value. Once a decision has been taken at time t, the option remains in force until maturity as either a call or a put. Normal chooser options are purchased in the current time and provide possessors the right for selecting at a later date, however, it is not known until the option reaches maturity whether it will ultimately be a put or a call. Keep in mind that the selection has two possible outcomes throughout the expiry date. Call options must expire with the asset above the strike price. By purchasing the item at a discount rather than exchanging it, the traders will profit in this situation. If the asset falls below the strike price, they will, nevertheless, exercise the put option. If owners choose to sell the bond here at a high price as opposed to dealing with it on the market, they will make money. The capacity of an asset to alter quickly is the key determinant of the pricing of chooser options. If the asset is very uncertain, the chooser option will be somewhat expensive. Investors who expect the underlying asset to fluctuate greatly but who are certain in the direction of the movement should select the safer alternative. The option holder will select the call option as it will be more valuable when comparing to the put option as the price of the underlying commodity increases over time. The put option would become the wisest decision if the underlying asset's value falls. Clients are the option's finest target market. They anticipate erratic change in an asset. They are unable to predict the exact course that the transformation will follow, though. For investors, the chooser option offers a number of benefits. The choice of whether it is a call or put is up to the owner of the stock or bond; and compared to a straddle, which enables the owner to select the call and put options simultaneously, this alternative is less expensive. What's more, a directional perspective is not necessary with chooser options. However, the chooser option has one significant flaw: it is really more costly than just one call or put.

A key idea in contemporary finance theories is the Black-Scholes model, sometimes referred to as the Black-Scholes-Merton (BSM) model. The future value of derivatives depending on certain financial instruments is calculated using mathematical model while also accounting for extra risk variables and the effects of time. Developed in 1973, the Black-Scholes model is now becoming a fine method to calculate how much an options contract would cost. The differential equation known as the Black-Scholes model is frequently employed to value options contracts. The current stock price, the remaining time to expiry, the risk-free rate, and the volatility are the five input parameters used. While a number of the presumptions by the Black-Scholes model are valid, they can occasionally result in forecasts that are incorrect. For instance, because it fails to take into account the likelihood of American options being executed prior to expiration, the conventional BSM model is solely used to evaluate European options.

The disparity between the stock's market price and the option's strike price can be regarded as the profit from a call option. Call options therefore increase in value as the stock price increases while decreasing in value as the strike price increases (fig.1). The payout upon execution for a put option is determined by the margin by which the strike price surpasses the stock price. As the stock price increases, the put option loses value while increasing in value when the strike price increases. Either the call or put American options appreciate in value throughout the course of the period remaining until expiration. The value of European put and call options does not necessarily increase when the expiration date approaches (fig.2 and fig.3), which is a result of certain long-life European option owners not having access to the same exercise alternatives as short-life European option holders. Besides, volatility is a gauge of our level of skepticism regarding future changes in stock prices. When volatility increases, the likelihood of which the stock's price may fluctuate in back and forth increases. Thus, when volatility increases, so does the value of calls and puts. It is less evident how the risk-free interest rate affects option pricing. Without further suppositions, it is challenging to predict how raising interest rates will affect the economy. Because rising interest rates decrease the current value of the exercise price, call values typically increase while put values decline. The fact that these findings presuppose that all variables stay fixed should be stressed. In reality, stock values often

increase when interest rates decrease or increase. Therefore, As a result, the change in interest rates and the related change in stock price might differ from what was previously spoken. r : interest rate; sigma : the underlying asset's implied volatility where the strike price is closest to the market price; delta : dividend rate; T : maturity time; spot price : current market price of a given asset; strike price : maturity time price.

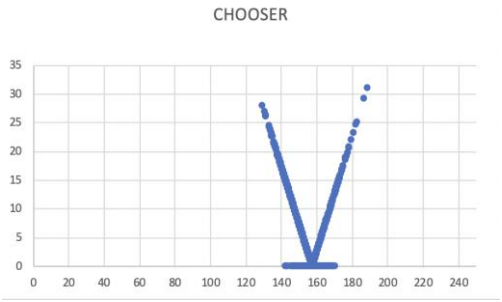

Fig. 1 Chooser option price-scatter plot simulation

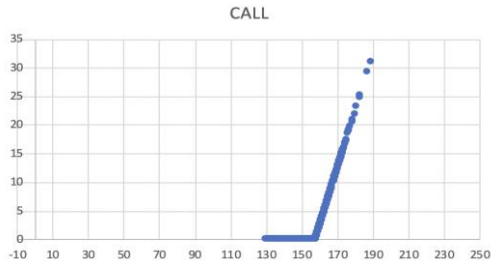

Fig. 2 Call option price-scatter plot simulation

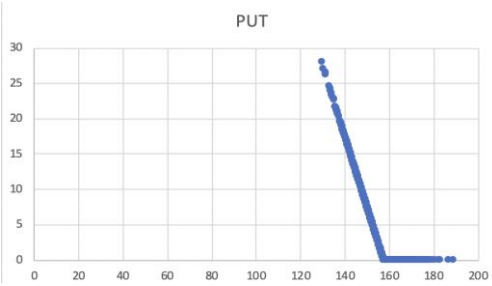

Fig. 3 Put option price-scatter plot simulation

4. Sensitivity Analysis

The pricing model procedure in sensitivity analysis is applied again, changing the dependent variables one at a time while leaving the rest unchanged. And Excel is used for what-if analysis. Stock price, maturity date, volatility, and pick-date time are some of the factors that we model.

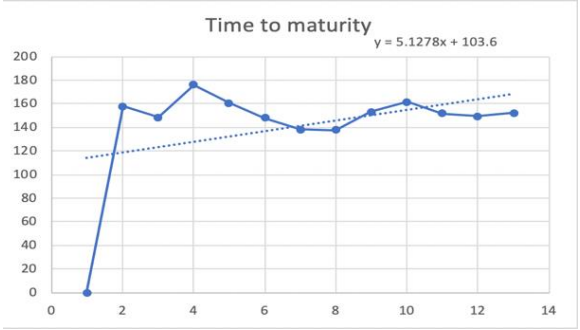

Fig. 4 Sensitivity Analysis of Time to Maturity

Fig. 5 Sensitivity Analysis of Time to Choose the Date

According to the results of the sensitivity analysis (fig.4 and fig.5), the time to pick the date has the most impact on the price of the chooser option. The second-highest sensitivity is between time to maturity. This is due to the fact that the longer the time frame, the more likely it is that the investors would make an incorrect market prediction.

5. Conclusion

Typically, Monte-Carlo simulation is applied to look at 1000 samples and assess the worth of several possibilities for the AAPL in the Black-Scholes model. Through carefully analyzing the volatility, dividends, rate of interest, and stock price of AAPL and using the stock simulation technique in Excel, payout for each sample is calculated. Additionally, the option's strike price and expiry rate are taken into account. The links between automated choosing of options and chooser options based on strike prices are provided. The study shows that both call options and put options are more expensive the more volatile the underlying asset is. Calls benefit from the upside, and puts benefit from the downside. With the increase in interest rates, the price of call options rises, and the cost of put options falls. The value of a chooser option is equal to the value of a normal call option if the contract's choice time equals the current day.

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