The Valuation of Google Snowball Option

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ABSTRACT
With the COIV-19 crisis, the risk in the stock market is more complex. It is crucial to managing the risk. Option as an important financial instrument to hedge risk would be considered commonly for investors. This article considers the option pricing model to establish a snowball option based on Google's stock price. The paper capture the option's price based on different scenarios. Moreover, the sensitivity analysis reveals that the higher the volatility, the higher the probability of knocking out early. The likelihood of "knocking in without knocking out" will increase and lead to a lower return. Also, the higher the knock-in price is, the easier the stock price will reach the knock-in price, and the probability of the option to be knocked in will be higher.

Keywords: *Option pricing, Finance, Google, knock-out*

1. INTRODUCTION

Since the 2020 pandemic, the uncertainty surrounding every aspect of the COIV-19 crisis has posed many threats to the stock market [1-2]. In addition to the high valuation of the stock market, the PE ratio for S&P 500 is at a historic high. Plus, the heavily mutated variant of Covid-19 identified in South Africa has rocked investor confidence [3]. However, as the government firm monetary policy, the stock price keeps crawling higher. In this unstable market but with an upward moving trend, it is hard for investors to stay invested as they face considerable risk if the stock market gets hit. Various type of option allows investor, and among them, a kind of barrier option snowball option provides the solution for us. [4-5].

With the popularity of snowball options, we need to create a model to understand how the pricing of snowball options is affected by knock-in and knock-out points.

Issuers (brokers) need to know how to price snowball options so that they can price snowball options. People who buy snowball options also need to understand how snowball options are priced. Because many banks wholesale a lot of snowball options, they need to reveal the current price of snowball options in real-time to let buyers know [6].

The Google company was founded in 1998 and is headquartered in Mountain View, California. Google is also a fast-growing company. The story of Alphabet, Google begins in 1995 at Stanford University. Larry Page and Sergey Brin are working in their dorm rooms and want to build a search engine that could use links to determine the individual information on the World Wide Web. They called this search engine Backrub. Nowadays, Google makes hundreds of products used by billions of people across the globe, from YouTube and Android to Gmail and, of course, Google Search. Alphabet Inc. provides online advertising services in this. It operates through Google Services, Google Cloud, and Other Bets segments. The Google Services segment offers products and services, such as ads, Android, Chrome, hardware, Google Maps, Google Play, Search, YouTube, and technical infrastructure and digital content. The Google Cloud segment offers infrastructure and data analytics platforms, collaboration tools, and other services for enterprise customers. The Other Bets segment sells internet and TV services and licensing and research and development services.

For the fiscal (and calendar) year 2020, Alphabet reported a net income of $40,269 million. The annual revenue was $182.5 billion, an increase of 23% over the previous fiscal year. The 41 analysts offering 12-month price forecasts for Alphabet Inc have a median target of 3,350.00, representing a +12.25%increase from the last

price of 2,984.29. Overall, Google is a strong buy for the current investor. However, buying Google stock is also based on different circumstances. Given the current unstable market condition, the suitable strategy for buying a good company such as Google is to use the snowball option (Figure 1).

Figure 1. Google's Stock Price from 2017 to 2021

2. METHOD

Snowball is a process that starts from an initial state of small amounts and builds upon itself, becoming larger and larger. And that is what we want to see in our money in our portfolio. Like the Treasury bonds and bills, municipal bonds, corporate bonds, and certificates of deposit, they will pay investors fixed interest or dividend payments until its maturity date. Snowball options also pay investor interest month by month if the Option knocks out or stays in between its knock and knock-in price [7]. Compared to the standard option, the snowball option is more likely to hit its (strike price) or knock-out price. So it means that there is a big probability that investors can make a profit out of it. However, the return is also lower. In sum, it means that investors have a high probability of earning a small amount of money and this process is just like rolling a snow price. And of course, snowball options are still risky, but it is less risky compared to the normal one.

The Snowball option also does not require investors to put more security deposit into the account if the underlying asset falls, since the maximum loss for the snowball option is the security deposit itself. Overall, the advantage is that the snowball option has a Lower risk since it has a higher probability of success. And a limited amount of loss.

Snowball option is a type of Barrier Option, and it has 2 barriers [8]. When the underlying asset reaches the high barrier, the option gets knocked out, and it knocks in when it reaches the low barrier. The "knocking out" is just like the safety switch and suggests that option's termination. The snowball type of income voucher sells a put option with a knock-in structure. If the underlying does not fall sharply, the longer you hold the income voucher, the more coupon income you will get, like a snowball, if the ground does not appear Very big loss, the snowball will roll bigger and bigger. It will have a total of 4 scenarios that can happen to this option.

Scenario 1: If the target's closing price is higher than its knockout price on a certain monthly observation day, the transaction ends early and the customer receives an annualized coupon.

Scenario 2: If the target does not touch the knock-in or knock-out boundary on any trading day and observation day during the duration, the contract will automatically end when it expires, and the customer will still receive annualized coupons.

Scenario 3: If on any trading day of the duration, the target has fallen below the knock-in threshold, and no knock-out event has occurred on all observation days before expiration if the price of the bid at the time of expiration is higher than the price at the beginning of the period, the customer can get all Principal, no other income.

Scenario 4: If on any trading day of the duration, the target has fallen below the knock-in threshold, and there is no knock-out event on all observation days before expiration, if the price of the bid at the time of expiry is lower than the price of the initial bid, the customer will bear the price the initial nominal principal corresponds to the total loss caused by the drop in the market value of the target.

Scenario 5: If, on any trading day of the duration, the target once fell below the knock-in threshold, and the knock-out event occurs again on an observation day before the expiration date, the transaction ends early and the customer receives an annualized coupon.

As can be seen from the above, in the market of snowball products with continuous volatility, the investment period is prolonged without tapping out or tapping in [9]. With the growth of time, the coupon keeps accumulating, and investors can maximize the best return. Therefore, the best profit scenario for Snowball products is a moderately rising, range-bound market. After the recent market correction, the downside space is limited, and the assumption that "the market will not fall deeply" is established. Meanwhile, the current market volatility is relatively low, and the market is in the stage of "grinding bottom", so the upward space is also not expected. Therefore, in the current continuous unstable of the market, is very suitable for snowball products

This paper considers the option pricing model to establish a snowball option based on Google's stock price [10].

3. RESULTS AND SENSITIVITY ANALYSIS

The initial stock price is 2833. The knock-out price is 3500. The knock-in price is 1000. The initial investment is 100. Do the simulation 1000 times and calculate the average option price, we will get the option price, which is 89.93. Then, we conduct sensitivity analysis for the option to capture the different influences of knock-out price, knock-in price, and sigma on options' price.

3.1 Knock-out Price

Figure 2 shows the relationship between the knock-out price and option price. If the knock-out price is very low, which means it is very close to the initial price. There is a high probability that it will knock out in the first several months. Thus, there is a low probability for the investors to lose money, and the option price will be high.

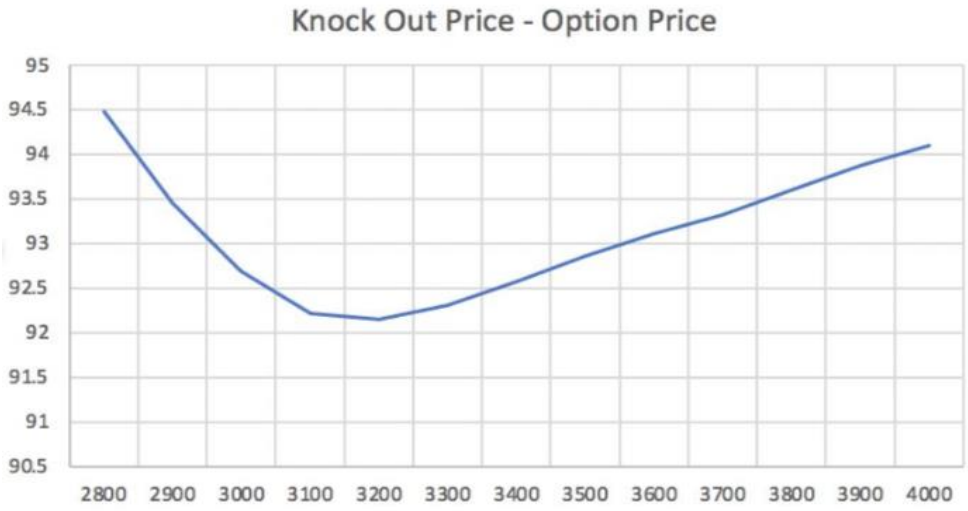

Figure 2. the impact of knock-out price on the option price

As the knock-out price increases, the probability of knocking out decreases, but holding the options longer is higher. However, since the reduction of the probability of knocking out is faster than the increase of the probability of holding the options longer when the knock-out price is below three thousand one hundred and five, the option price will decrease.

If the knock-out price is higher than three thousand one hundred and five, when increasing the knock-out price, since the increasing probability of holding the options longer is faster than the decreasing probability of knocking out, the option price will increase.

If the knock-out price is very high, although there is not a high probability for knocking out, the annual return will be very high, and the probability of holding the option to maturity is high. As long as it does not knock in at maturity, the investors will gain a high return.

In conclusion, the smaller the knock-out price, the easier the stock price will reach the knock-out price. Thus, the option will have a larger probability to knock out early, and the investor will get a lower return in the short run and lose the higher return of the scenario of “neither knocking out nor knocking in”.

3.2 Knock-in Price

If the knock-in price is low, the probability of knocking in is low since it is harder for the stock price to go below the knock-in price. As long as the option does not knock in, the investors will not lose money. Thus, if the knock-in price is low, the expected return of the option is high, and the option price is high.

When the knock-in price becomes higher and higher, the probability of knocking in becomes higher and higher. It becomes more accessible for the option to knock in. The likelihood for the investors to lose money

becomes higher and higher. Thus, the option price becomes lower and lower.

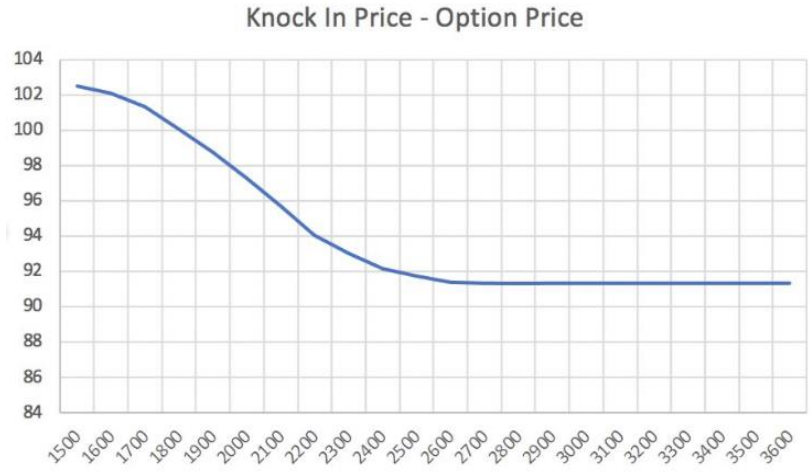

Figure 3. the impact of knock-in price on the option price

If the knock-in price is too high, which means that the option is sure to knock in, then the option's return is fixed, since the return of the option is fixed if the option is sure to knock in. Thus, if the knock-in price is higher than the stock's initial price when the knock-in price becomes higher and higher, the option price will keep the same (Figure 3).

In conclusion, the higher the knock-in price, the easier the stock price will reach the knock-in price, the probability of the option to be knocking in will be higher. If the option will not knock out later, it will be the same as a put option, and the investor might lose money if the stock price is lower than the strike.

Figure 4 shows the relationship between the sigma and option price. As long as the stock price is above the knock-in price, the investors will get returns. Thus, the lower the volatility, the lower the probability for the stock price to be equal to or smaller than the knock-in price, the probability for investors to get returns will be higher, so the option price will be higher.

Conversely, the higher the volatility, the lower the option price, for similar reasons.

In conclusion, the higher the volatility, the higher the probability of knocking out early, or the higher likelihood of "knocking in without knocking out" will be higher, the lower the return.

3.3 Sigma

Figure 4. the impact of sigma on the option price

4. CONCLUSION

Nowadays, Snowball options are popular. Both buyers and sellers should know how to price the snowball options. Snowball options are barrier options, they have knock-in prices and knock-out prices. We use MC Method to price the Snowball option of Google stock.

The buyer of snowball products is shorting the volatility, so choosing a time window during which the volatility declines during the duration is more conducive

to gaining income. Secondly, in the five scenarios of the snowball structure listed in the previous chapter, only one will have a principal loss, that is, if the target falls below the boundary, so if the investor can predict that the target price will not occur during the lifetime Larger downturns can also be invested to obtain coupon income. At the cost of a small probability of a large loss, in exchange for a stable income with a large probability. This kind of product is very suitable for continuous investment in the case of long-term maintenance of narrow fluctuations in the market without obvious trends and obtaining coupon income.

This article also exists limitations. This paper only studies the snowball option of Google stock. It does not study snowball options of different stocks or different snowball options of one stock. Thus, this paper cannot give a conclusion about the comparison between different kinds of snowball options. In the future, we could focus on different kinds of snowball options and compare them and provide information for buyers and sellers to choose better snowball options.

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