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## Buffett's Derivatives: Disruptive Financing at Low Cost

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## Buffett's Derivatives: Disruptive Financing at Low Cost

### Abstract

The well-established methodology for valuing options, the Black & Scholes formula, has been successfully challenged by Warren Buffet; who not only has been critical of the formula for the case of long-dated options, but has also applied a different approach in multi-billion derivative contracts. We study Berkshire Hathaway's Equity Put transactions from a value-investing point of view. We show that Buffett is not using them as speculative investments, but as a disruptive -and cheap- financing source. We uncover Buffett's methodology for valuing long-dated Equity Puts as long-term loans.

### Keywords

value investing, derivatives, Warren Buffett, Berkshire Hathaway, Put Options, tail risk, loan, disruptive financing

### Acknowledgements

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## I. Introduction

Derivatives are “dynamite”, “time-bombs”, “toxic material”. Like Hell, they are “easy to enter and almost impossible to exit”. Warren Buffett’s crusade against financial derivatives has been known for years, especially since that renowned letter to Berkshire’s stockholders of 2002, where he labeled them “financial weapons of mass destruction” (Buffett, Chairman's Letter (2003) p. 15).

At the time, general belief was different. “These increasingly complex financial instruments have especially contributed, particularly over the past couple of stressful years, to the development of a far more flexible, efficient and resilient financial system than existed just a quarter-century ago," said Alan Greenspan back in 2002, as Chairman of the Federal Reserve (Berry (2003)). Derivatives were supposed to be tools to reduce risk, not to increase it.

Buffett introduced then a contrarian concept, alerting about the “daisy-chain” reaction derivatives could cause in the markets. His view was that these type of vertiginous high-levered strategies were like playing with fire; that managers don’t understand them, and even advanced financial analysts or prestigious auditors fail to review them. They represent a risk of such magnitude that, when already present in an acquired company, such as it happened with General Re (a Berkshire subsidiary), Buffett took personally the responsibility to disarm them, apologizing to the stockholders for some inevitable losses in the process (Buffett, Chairman's Letter (2004)).

However, following this lead, most value investors took an excessively simple (and convenient) approach towards derivatives: they are risky, we don’t understand them, we just stay away. This is why, between 2004 and 2008, the news of Berkshire Hathaway signing billions of dollars in these type of contracts surprised them, and confused them. After all the warnings, why is Buffett playing Russian roulette with his own company? Has he developed an edge on

derivatives valuation? What has he discovered on the matter, solid enough not to publish an academic paper, but to risk several billions of dollars?

It has been difficult for academic literature to address these questions, as Buffett insights are frequently disruptive and cannot be approached directly from mainstream theories. In the following pages, we will show how Buffett is challenging the traditional Black & Scholes methodology for valuing options, and creatively using derivatives as a cheap financing source, in the form of a long-term loan that could eventually be defaulted. This paper is organized as follows. In section II, we discuss previous academic advances on the topic. In section III, we analyze Warren Buffett's explanations, contrasting them to the prevailing valuation methodology (Black & Scholes). In section IV, we show how the derivatives "float" is understood by Buffett as a long-term loan, that has a chance of being legally defaulted. In section V, we discuss the hidden transfer of tail risk included in Berkshire's Equity Put Options. Finally, in section VI, we summarize what we believe to be Buffett's methodology in analyzing European Put Options, and we make concluding remarks.

## **II. Literature Review**

Frazzini, Kabiller & Pedersen (2013) studied Berkshire's alpha, concluding that the company's extraordinary returns appear to be a reward for: a) a focus on cheap, safe, quality stocks, and b) the use of leverage to achieve large returns at a higher risk. To obtain the second conclusion, they measure leverage in two alternative ways. First, they compare Total Assets (minus cash) to Equity, observing that Berkshire's leverage, for the period 1976-2011, has been on average 1.6 to 1. Then, they identify that the two major liabilities on the Balance Sheet are debt and insurance

float; and thus include a second measure of leverage, as  $(\text{Equity} + \text{Debt} + \text{Float})/\text{Equity}$ , concluding that the company had on average a 1.4 to 1 ratio. For them, this is not a trivial amount of leverage.

When studying the costs of such leverage, they separate: 1) cheap debt, which was AAA-rated for a long time, and 2) insurance float -the result of collecting premiums up front and paying a diversified set of claims later- which they estimate to be even below the average T-bill rate. We will add a third extremely inexpensive financing source, the derivatives float.

Pablo Triana (2013) added some light by focusing on the funding side of the equation, as the stock selection side has already been subject to plenty of scrutiny. Triana sustains that, to obtain such vast and affordable funding, Buffett is simply willing to take on a lot of risk. First, he followed the evolution of the 2004-2008 Berkshire's derivative trades. Then, in a subsequent paper (Triana, Buffett's puts: what are the risks? (2014)), he focused on the Equity Put portfolio, separating Berkshire's derivatives risk in two types: accounting risk and settlement risk. For the accounting part, he provided a risk analysis based on the option Greeks.

Bradford Cornell (2010) studied the valuation of long-dated options, emphasizing the effects of government interventions. For Cornell, if governments are expected to respond strongly and aggressively in times of crisis, providing liquidity to the stock markets, then the Black & Scholes assumption that nominal stock returns follow a lognormal distribution over the long-term, with volatility that can be estimated from historical data, is not realistic. Cornell relates this problem to Warren Buffett's criticism of the Black & Scholes formula, speculating that, if inflationary policies of governments and central banks indeed limit future declines in nominal stock prices -compared with those predicted by an historically estimated lognormal distribution- then Buffett might be right, as the model will significantly overvalue long-dated put options.

The “volatility smile” (the non-symmetrical skew, i.e. the increase in volatility as Puts become increasingly in the money) is apparently neglected by Berkshire, as the company employs essentially a constant volatility input (Triana, Buffett and Black-Scholes: what does volatility mean? (2014)).

These arguments are mostly approached from Buffett’s point of view. Alternative questions might arise if the counterparty angle is explored, e.g. the Equity Put buyers’ motivations to enter such deals. It is easy to imagine that, for someone using Black & Scholes as a valuation model, buying an insurance against an equity index decline might have appeared a great deal, at least at first sight. Nevertheless, considering the involved amounts of money, it is reasonable to think that the buyers were finance professionals with knowledge of the topic, and that they did their job, performing a thorough analysis of the trades. Why did they bet against the stock indexes? Was the apparent high valuation of the options the only reason for them? Or is it possible that they were after the “mark-to-model” accounting advantages described by Buffett in his 2002 chairman’s letter? Buffett explains that, when dealing with “mark-to-model” derivatives that have distant settlement dates, it is possible to show substantial profits for years (Buffett, Chairman's Letter (2003)).

### **III. How is Buffett Defying Black & Scholes**

During the 2004-2008 period, Berkshire Hathaway sold derivatives that fall into four categories: 1) credit default protection on companies included in various high-yield indices, 2) credit default swaps on individual companies, 3) tax-exempt bond insurance contracts structured as derivatives, and 4) European Put Options on four major equity indices -the S&P500 in the U.S.,

the FTSE 100 in the U.K., the Euro Stoxx 50 in Europe, and the Nikkei 225 in Japan. In this paper, we will focus exclusively on the latter, the “Equity Put Portfolio”.

Since the referred 2004-2008 period, the financial statements of the company have shown derivative gains and losses in the range of billions of dollars, as well as Black & Scholes estimated assets and liabilities, most of which occur without any money changing hands. In accounting terms, most Berkshire derivatives are not recorded as “effective hedges” but as pure speculative, thus reflecting changes in their fair value as accounting earnings or losses (“mark-to-market” accounting when possible, and “mark-to-model” for not standard, not exchange traded contracts, labeled “level 3”).

Notwithstanding Buffett's unbelief of the reliability of the Black & Scholes formula (at least in the case of long-dated options), the model is the one selected for accounting purposes, in order to avoid suspicion in departing from a well-established standard. In Warren Buffett words, “The formula represents conventional wisdom and any substitute that I might offer would engender extreme skepticism” (Buffett (2009) p. 21).

A large part of the research on this topic has focused on Black & Scholes functioning. For example, on the effect of using a constant volatility input (Triana, Buffett and Black-Scholes: what does volatility mean? (2014)), or the result of small changes in the assumptions (Triana, Buffett's puts: what are the risks? (2014)). These changes, measured by “the Greeks”, are not uniform in all types of Equity Puts. Triana breaks down the analysis into short-dated and long-dated options. As Berkshire is on the seller side of European Equity Puts, an increase in the Black & Scholes valuation output will elevate the company's reported liabilities. The “Greeks” capture the effect of small changes on each of the model assumptions. Underlying asset risk (“delta”) positively affects Berkshire's position when equity indices rise (and the opposite when they go down), but this is

only true for short-dated options. In the case of long-dated Puts, delta risk is negligible, even if the option is in-the-money. Price-jump risk (“gamma”), the sensitivity of delta to changes in the underlying asset, negatively affects option sellers, but has no material effect on long-dated options. Volatility risk (“vega”) critically hurts option sellers, and could have a significant effect in both short and long-dated options. Time risk (“theta”) is generally assumed positive for Put sellers, who will see a reduction in reported liabilities due to the passage of time; but could have a different effect for Puts that are in-the-money. Whatever the case, theta is also non-material (close to zero) for long-dated Put Options. Finally, interest rate risk (“rho”) is positive for Put sellers, as an increase in interest rates will reduce Black & Scholes Put values, lowering the seller’s liabilities on the balance sheet. Rho can be extremely significant for long-dated Puts (put sellers are basically long on interest rates), becoming a critical input for the type of options sold by Berkshire. According to Triana, “Berkshire’s fate was firmly placed into Rho’s hands” (Triana, Buffett's puts: what are the risks? (2014) p. 41).

In short, summarizing the mentioned effects and contrasting the differences between a short and a long-dated option, we may observe that, in the latter, only changes in volatility and interest rates appear to be relevant. The Greeks analysis is altered by the length of the contracts (Figure 1).



## European Put Option's Greeks

Risk type:		Impact on European Puts sold:	
		Short-dated	Long-dated
Delta underlying asset's risk	↑	Equity Indexes (+)	n/m
Gamma jump risk	↓	Equity price-jumps (-)	n/m
Vega volatility risk	↓	High volatility (-)	large impact
Theta time risk	↑	Passage of time (+/-)	n/m
Rho interest rate risk	↑	Higher interest rates (+)	large impact

Figure 1. Effects of small changes in the Black & Scholes assumptions, for short and long-dated European Put Options.

But there is one risk not captured by the Greeks, and it happens to be the essential one for Warren Buffett. The only risk he is not willing to bear, not even for a fee. The risk that can cause the feared “daisy-chain” reaction, and turn derivatives into weapons of mass destruction: the credit risk. For short-dated contracts, the risk that the counterparty won't comply with the option's payoffs might go unnoticed, but in the case of Berkshire's European Put Options, with expiration dates between 2018 and 2026 (for contracts signed in the 2004-2008 period), credit risk becomes a key input for valuation. Moreover, during the 2008 financial crisis, it became evident that it was an awfully expensive risk to hedge.

Warren Buffett's letters do not show a concern about Black & Scholes inputs. As it was mentioned, Berkshire uses a constant input for volatility -overlooking the academic debate on the

“volatility smile”-, it does not care about earnings swings -as derivative gains and losses are mostly non-cash charges-, and downplays mark-to-model estimated liabilities -as they might be significantly overstated. In Warren Buffett words, “Our ultimate payment obligations, if any, under our remaining equity index put option contracts will be determined as of the contract expiration dates, which begin in 2018” (Berkshire Hathaway Inc. (2014) p. 49).

Long-dated contracts substantially increase the credit risk, which is not taken into account in the Black & Scholes model (some finance professionals add a premium). The additional risk is faced only by the option buyer, as Berkshire, on the other side, simply collects premiums in advance. As Warren Buffett explains it: “A normal stock or bond trade is completed in a few days with one party getting its cash, the other its securities. Counterparty risk therefore quickly disappears, which means credit problems can’t accumulate [...] Derivatives contracts, in contrast, often go unsettled for years, or even decades, with counterparties building up huge claims against each other” (Buffett (2009) p. 17).

In European Put Options with expiration dates that will occur decades after the contract signing, Buffett has identified the credit risk as the most significant element of valuation. Thus, the absence of collateral is the only condition he is not willing to surrender. In the 2004-2008 period, when negotiating derivatives, Berkshire reduced posting requirements to a minimum. The notes to financial statements of 2008, during the financial crisis, stated: “Only a small percentage of our contracts call for any posting of collateral when the market moves against us. Even under the chaotic conditions existing in last year’s fourth quarter, we had to post less than 1% of our securities portfolio” (Berkshire Hathaway Inc. (2008) p. 18).

The collateral importance has been stressed in many of Warren Buffett letters, clarifying that the company would only agree to post collateral in cases of little significance: “we don’t enter

into contracts that could require postings of collateral except for amounts that are tiny in relation to our liquid assets” (Buffett (2011) p. 24). When Berkshire no longer could negotiate collateral-free contracts, derivative transactions were put to an end: “Though our existing contracts have very minor collateral requirements, the rules have changed for new positions. Consequently, we will not be initiating any major derivatives positions” (Buffett (2012) p. 17).

The disruptive understanding of derivatives, we suspect, might have been originated in Buffett's long experience in the insurance (and reinsurance) business. If there is one business Warren Buffett understands, it is insurance. Berkshire has a clear competitive advantage in this area, and with the help of European Put Options, Buffett just extended it to the derivatives arena. In Buffett's words: “Indeed, we have a major competitive advantage because of our tolerance for huge losses. Berkshire has massive liquid resources, substantial non-insurance earnings, a favorable tax position and a knowledgeable shareholder constituency willing to accept volatility in earnings. This unique combination enables us to assume risks that far exceed the appetite of even our largest competitors” (Buffett (2002) p. 9).

Insurance is at Berkshire's core business, and the assessment of worst-case scenarios is within its circle of competence. We frequently read in Buffett's letters about losses from hurricanes and “mega-catastrophes”. Unlike finance professionals with a strong Black & Scholes mindset, nor Buffett, nor his investors really care about interim volatility of earnings. They seem to be focused only on the final result, disregarding intermediate Black & Scholes valuation outputs.

As in the tennis Davis Cup, where the locals get to choose the surface in with the sport is played, Buffett has chosen to sign extremely long-dated options; completely changing the game. In this surface, the dynamic of Black & Scholes completely changes: “If the formula is applied to extended time periods, however, it can produce absurd results” (Buffett (2009) p. 20). By focusing

solely on the long term, and negotiating collateral-free contracts, Buffett does not seem to care about intermediate accounting losses, nor to find use for the Black & Scholes Greeks analysis. The Greeks effects, whether positive or negative, produce merely accounting risk, “phantom losses”, at least. Without collateral –in other words, no money changing hands- Buffett turns away from Black & Scholes. For valuation purposes, he does not need to calculate intermediate accounting earnings or losses, as for him, only settlement risk counts. Instead of making predictions with the model, he simply alerts his stockholders that Black & Scholes will only have an accounting use, and that reported earnings might be volatile, and reported liabilities overstated. Buffett establishes the similarity with insurance, estimating for example that, for the \$631 million derivatives losses of 2008, using accrual accounting (the standard for equivalent operations in insurance), would actually result in a small “profit” (Buffett (2009) p. 20). Not all types of investors will, of course, remain immutable in the presence of billions of dollars in accounting losses; but most Berkshire shareholders are acquainted with its long-term investment strategy, and the temporary setbacks it might cause.

The main way in which Warren Buffett is challenging the Black & Scholes model is, as we see it, in the recognition of the formula’s missing element, the credit risk. Unlike most investors and practitioners, for whom Black & Scholes is simply accepted as a standard methodology, Buffett identifies a critical point in which the formula fails, and magnifies its effect by extending the options expiration dates. In long-dated options, none of the five inputs taken into account by Black & Scholes seem to be as important as the missing one. If the option buyer, even in the best-case scenario, will have to wait decades to collect the option payoffs, then counterparty credit risk escalates.

In other words, in the valuation of European Put Options, Warren Buffett exploits Black & Scholes inability to take into account credit risk<sup>1</sup>, maximizing its effect by signing long-dated contracts.

#### **IV. Derivatives as a Long-Term Loan**

Once all the noise of the non-cash earnings and losses has been disregarded, as well as the confusion of “paper” assets and liabilities, what remains in Berkshire's Equity Put Options is a long-term obligation that depends on the level of the equity indices. Of course, after decades of Black & Scholes being taught in Business Schools as the standard methodology for valuing options, and general acceptance as a standard methodology (at least for financial statements), it takes courage to depart from it. Buffett does it in this rare scenario he has created, where the formula appears to produce absurd results.

Understanding derivatives as speculative investments will not lead to meaningful results when analyzing Buffett's strategy. For speculative investments to be successful, equity indices should end up above strike prices, allowing Berkshire to keep the Equity Put Options premiums. In other words, profiting from the derivatives transaction. But this is not the way in which Warren Buffett is describing the trade. He is not picturing it as an investment decision, but as a financing one. Thus, even if a payout (and the corresponding “loss”) is finally determined at expiration, Berkshire still might win; as long as the payoff remains inferior to the collected premiums, plus a reasonable cost for the use of capital. It is not a speculative loss at all. When the payoffs turn out to be lower than the premiums received up-front, Berkshire lands positive “float”, which is, in essence, funding at a negative interest rate.

Buffett is understanding the derivatives transaction as an insurance-like one, and explicitly saying so: “Indeed, the thought processes we employ in these derivatives transactions are identical to those we use in our insurance business” (Buffett (2011) p. 19). He is not using derivatives as hedge or speculative investments, but as financing contracts. The main point, as he has expressed in most of the letters covering derivatives, is the “float”, the difference between the collected premiums and the loss payments made (if any). In the insurance business, Buffett considers the use of the float one of the key advantages of such activity. Now, using collateral-free European Put Options, he has designed derivatives float to be essentially the same, the use of (eventually) free money to be invested at Berkshire’s benefit.

The view of the derivative’s float as a funding source pushes the break-even point below the strike price. For Berkshire to actually lose money with the European Put financing transactions, underlying assets prices should end, at expiration date, below strike price plus a charge for the use of the funds (in this case, by a AA-rated company). Whenever they end up above, the company adds value from the financing side of the equation.

Since 2007, when the first contracts were signed, Berkshire Hathaway has been maintaining an average of \$4,4 billion on derivatives float, for the Equity Puts only. The contracts start to expire in 2018, and thus we may expect the float to be gradually reduced, but it has represented a significant financing source for the last decade. Although the financial statements show assets, liabilities, gains and losses for these operations, the relevant numbers for value investors are not there; they need to be found in the notes. The reported numbers both in the Balance Sheet and in the Income Statement are “mark-to-model” numbers (being Black & Scholes the model chosen by Berkshire), and thus Buffett calls them “paper assets”, “paper liabilities” and “phantom losses”. The derivatives float is not directly shown in the financial statements; it can be

found in the notes to the financial statements and in Warren Buffett's letters to shareholders. The derivatives operations started in 2007, right before the financial crisis, and at the time Berkshire collected \$4,5 billion in Equity Put premiums, increasing them the following year to \$4,9 billion. Most of these funds are still in the company, and invested for its own benefit. From the originally received premiums, only \$647 million correspond to contracts that were unwound (in the last quarter of 2010), resulting in a payoff of \$425 million and in realized earnings of \$222 million. The remaining float has been approximately \$4,2 billion since then (Figure 2).

### Berkshire Hathaway's Equity Put Float

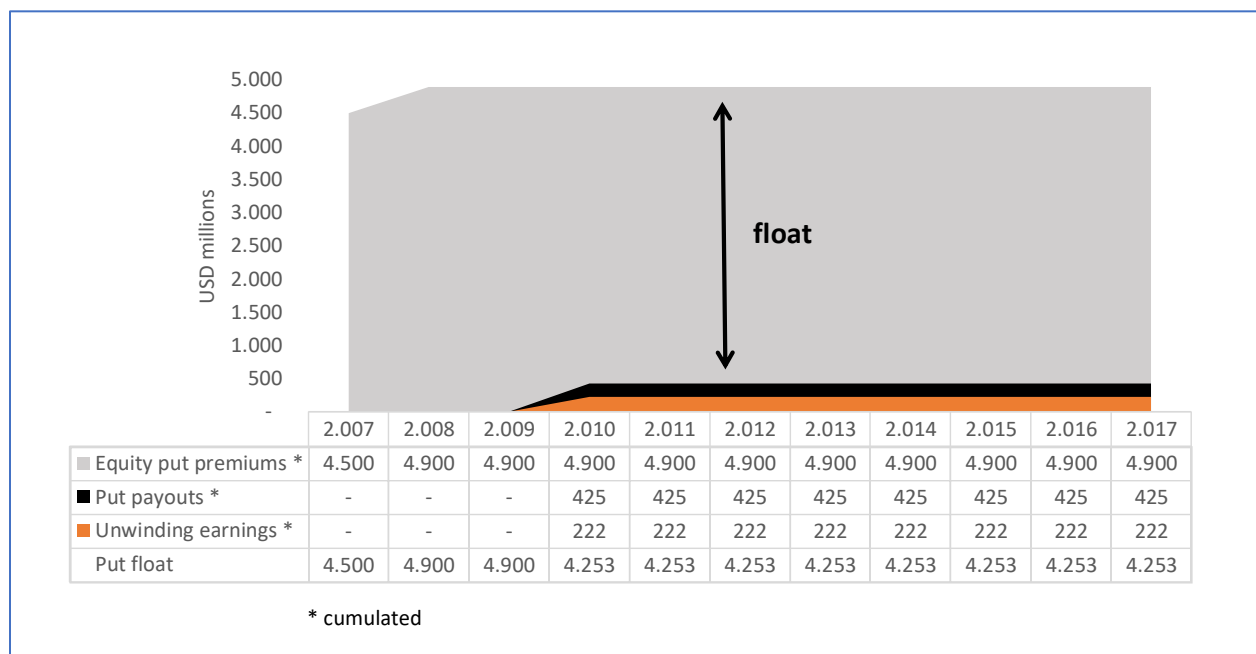


Figure 2. Berkshire's Equity Puts Float, calculated as the difference between the collected premiums and the corresponding payouts and unwinding earnings.

To understand why Buffett's interpretation of these transactions is contrarian, differing not only from the general view but also from the accounting practices, we may dissect the numeric example that he provided. At the peak of the derivatives momentum, and in the middle of the

financial crisis, Buffett included, in the 2008's letter, a remarkably simple view of the multi-billion dollar Put transactions. With no fear of looking naive, in front of highly sophisticated and mathematically overloaded modern financial theories, the Sage of Omaha offered an explanation of the Equity Put Option transactions rooted in only a few elements, as a long-term loan associated with a probability of not being repaid. Simplicity, for Buffett, is a virtue.

The complete explanation, in Warren Buffett's words, is as follows: "So let's postulate that we sell a 100-year \$1 billion put option on the S&P500 at a strike price of 903 (the index's level on 12/31/08). Using the implied volatility assumption for long-dated contracts that we do, and combining that with appropriate interest and dividend assumptions, we would find the "proper" Black-Scholes premium for this contract to be \$2.5 million [...] Considering everything, I believe the probability of a decline in the index over a one-hundred-year period to be far less than 1%. But let's use that figure and also assume that the most likely decline – should one occur – is 50%. Under these assumptions, the mathematical expectation of loss on our contract would be \$5 million (\$1 billion x 1% x 50%). But if we had received our theoretical premium of \$2.5 million up front, we would have only had to invest it at 0.7% compounded annually to cover this loss expectancy. Everything earned above that would have been profit. Would you like to borrow money for 100 years at a 0.7% rate? Let's look at my example from a worst-case standpoint. Remember that 99% of the time we would pay nothing if my assumptions are correct. But even in the worst case among the remaining 1% of possibilities – that is, one assuming a total loss of \$1 billion – our borrowing cost would come to only 6.2%. Clearly, either my assumptions are crazy or the formula is inappropriate" (Buffett (2009) p. 20).

The transaction is hence broken down by Buffett in two scenarios: a general case, with a high probability, and a worst case, with a very low probability (Figure 3).



Buffett's Put option example

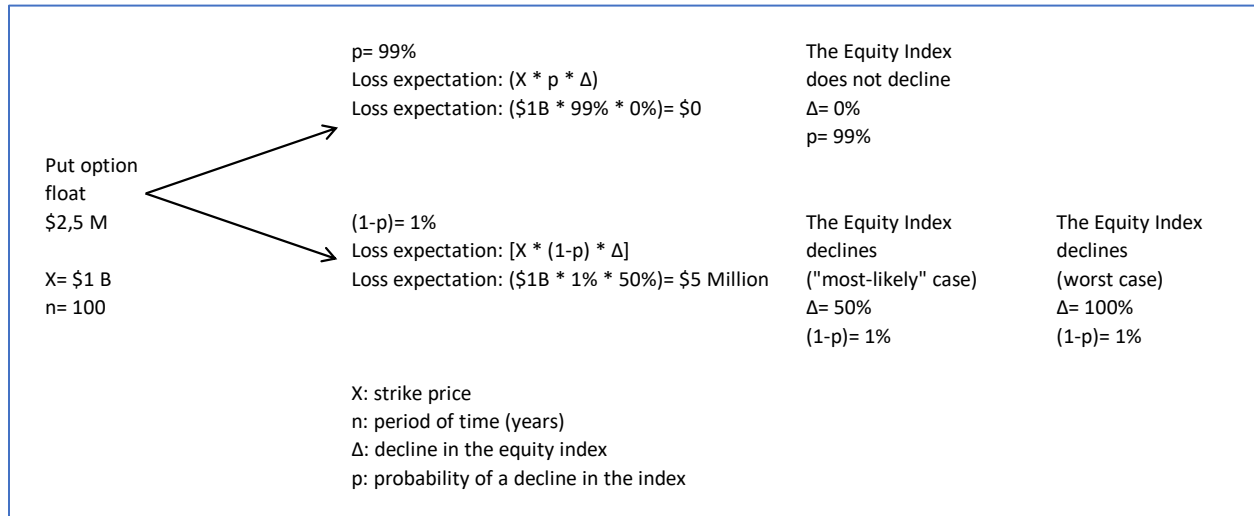


Figure 3. Diagram of the Put option example provided by Warren Buffett in the 2008 letter to Berkshire Hathaway's stockholders.

Thus, the description of the European Equity Put as a long-term loan, is as follows. Let "B" be the Float (in other words, the amount of borrowed money), "X" the Strike price at the time of expiration, "S" the option's underlying asset (the Equity index), "n" the number of years to expiration, "Δ" the percentage decline in the Equity index, "F" the option's (negative) payoff at expiration (equivalent to the face value of the loan), "p" the probability of a decline in the Equity index, and "r" the annual cost of financing.

Hence, in the same way the value of a zero-coupon bond or a simple loan can be estimated discounting the Face value at the cost of financing (Equation 1), the relationship between the borrowed money in the option contract (the "float", which initially will match the Equity Put premium) and the principal to be paid-off at the end of the contract ("F") will determine the cost of financing ("r").

*Equation 1*

$$B = \frac{F}{(1+r)^n}$$

Clearing  $r$ , we find that the annual cost of financing is calculated by Warren Buffett consequently as follows (Equation 2):

*Equation 2*

$$r = \left[ \frac{F}{B} \right]^{1/n} - 1$$

Finally, applying Equation 2 to Buffett's example (Buffett (2009) p. 20), we may verify that the financing costs included in the Stockholder's letter can be computed with the referred equation: in the "most-likely" case, where the expected index decline is 50%, the resulting financing cost is calculated by Buffett as 0.7%, and in the "worst-case", where the expected decline is 100%, the financing cost estimated in the Stockholder's letter is 6.2% (Figure 4).

Example, Buffett's formula for the cost of financing

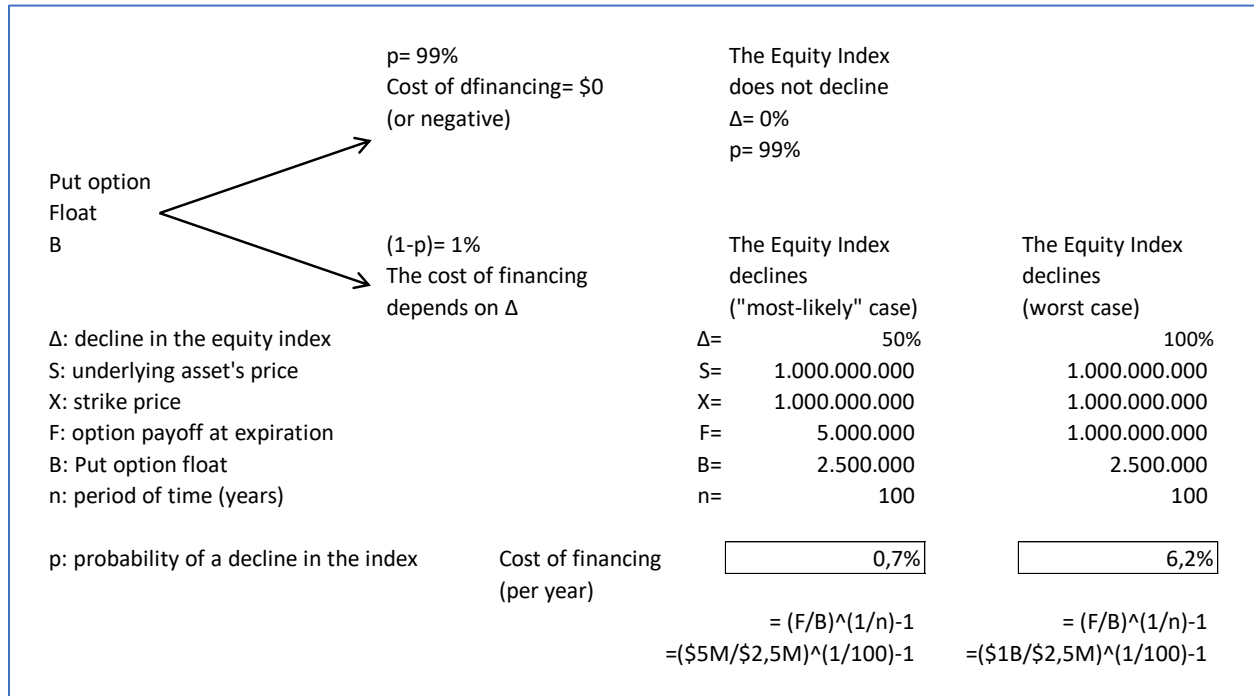


Figure 4. Analysis of Warren Buffett's example, employing Equation 2 to estimate the financing cost.

## V. Tail Risk Transfer

One of the big problems of the theories that rely on bell-shape curves and ignore the impact of the tails (the extreme events) is that they produce outcomes that are blind to significant risks. Nassim Taleb, known for being very critical of these theories, explains in his last book that whenever there is an asymmetry between a bonus period received by the traders (e.g., yearly) and the “statistical occurrence of a blowup” (e.g., every 10 years), the agents have an incentive to play a risk-transfer game. In Taleb's opinion, “Given the number of people trying to get on the money-making bus, there is a progressive accumulation of Black Swan risks in such systems. Then, boom, the systemic blowup happens” (Taleb (2018) p. 41).

A “tail” is an extreme event of low frequency. For financial traders, according to Taleb, the best place to hide risks is “in the corners,” in burying vulnerabilities to rare events that only the architect can detect; e. g. making sure that the problems arise far ahead in time. He specifically applies this concept to options, describing the two parts involved in the contract in the following way: “One, the fool, takes risks he doesn’t understand, mistaking his own past luck for skills, the other, the crook, transfers risks to others” (Taleb (2018) p. 23).

Is it possible that Warren Buffett’s understanding of Put options, while not mathematical, would assign a meaningful status to tail risks, making sure to transfer them to hungry-for-bonuses traders? Was Buffett aware of the extreme events risks, and confident that he could find a counterparty for the long-dated Put Options? (a counterparty focused on short-term bonuses, and backed-up by Black & Scholes blindness to tails). There are certain affirmations in Buffett’s letters in support of this hypothesis. He pays a particular attention to government aids in times of crisis, trusting that, in times of crisis, governments will use taxpayer’s money to save those affected by the extreme events. The size of the contracts might also have responded to this idea. As he has expressed, when discussing government aids: “only companies having problems that can infect the entire neighborhood [...] are certain to become concern of the state” (Buffett (2009) p. 18). In Taleb’s description, this would make Warren Buffett, “the crook”.

In line with this idea, Bradford Cornell (2010), as mentioned above, interprets that Warren Buffett’s critique to Black & Scholes boils down to the belief that, due to government intervention -with massive bailouts in times of crisis- future nominal stock prices are not well approximated by a lognormal distribution with volatility estimated from historical data.

In the last quarter of 2010, as it was mentioned in the previous section, Berkshire unwound eight contracts, for which they had originally received premiums of \$647 million, and

the unwinding required only a payment of \$425 million, resulting in a realized gain of \$222 million for Berkshire. All of this, according to Buffett, took place “at the instigation” of their counterparty (Buffett (2011) p. 20). The previous year, they had also modified the terms of about 10% of the Equity Put contracts, shortening maturities and reducing strike prices (both reducing Berkshire's liability), but at no cost, without any money changing hands (Buffett (2010)).

Why would Berkshire's counterparty insist on disarming a Put option contract, at a huge loss? The tail risk transfer is a possible explanation. When long-dated contracts are not collateralized, their ultimate value strongly depends on the creditworthiness of the seller (assuming, of course, that premiums have been collected at the beginning, as it is the case with Berkshire contracts). But the credit risk is not constant along the life of the option. As the Put turns more convenient for the buyer, with a decline in the equity indexes, the risk that the seller will not fulfill its obligation turns higher, turning the hedge more expensive, as it could be seen with the significant increase of Berkshire's Credit Default Swaps. When the Put Option turns more beneficial for the buyer, at the same time the cost of hedging it in the CDS market increases, providing Berkshire with an advantageous position to renegotiate the deals in the tails. According to Pablo Triana: “Whether intentionally or not, Berkshire sold a derivative that contains an in-built accounting edge, and hedge, for the seller” (Triana (2014) p. 7).

Understanding the long-dated European Equity Puts as a financing source, in the form of a derivatives float, has the effect of changing the perspective; and thus capital structure theories, as Modigliani & Miller's, now apply. According to M&M Proposition II, when a firm reaches a point of high leverage, a risk-transfer occurs: the stockholders transfer part of the risk to the bondholders. In other words, without any regard to the written bond contract, the holders of risky debt start bearing some of the firm's business risk.

## **VI. Conclusion**

The disruptive concept introduced by Warren Buffett with respect to derivatives consists in treating them not as hedges or speculative investments, but as cheap financing contracts. The European Put's "float" is understood by Buffett as a long-term loan, whose payment has a chance of not being claimed at the end of the contract. The implied financing cost can thus be computed setting a parallelism between the derivatives float and the loan's borrowed amount.

In the case of long-dated European Puts, this approach deeply challenges Black & Scholes, the standard methodology for valuing options. By pushing the contracts to long maturities, Buffett not only takes a contrarian view (trusting that most investors will not assign a meaningful status to extreme events risks), but also succeeds in transferring tail risks to his counterparties.

## Footnotes

1. If we differentiate default risk and credit risk, defining the former as the risk that the issuer of a fixed-income security will be unable to make timely payments of coupons or principal; and the latter as the risk that the perceived credit quality of an issuer may change (although not necessarily in default), then our analysis applies to both.

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