Imagine you buy an option from someone. You pay some money today for the option. What risks are you facing? Well, you obviously would want the value of that option to go up and to deliver a payout at maturity. So you would typically want the underlying asset to move in your favour (up if you bought a call option, down if you bought a put option), volatility to increase, and interest rates to also swing your way. But you should also be concerned about the credit quality of your counterpart. The option, an asset to you, creates liabilities for the other party. If they can’t cover those payment obligations, whether expected or actual, you won’t enjoy a positive return from your investment, no matter how much the underlying relevant variables moved favourably to your position. This credit risk has traditionally been less focused on than market risks, but things changed drastically after the last financial crisis, as everyone was forcefully reminded of the key relevance of such exposure. Counterparty risk is nowadays a central factor in trading floors, risk management departments, and bank regulations all over the world. If you buy an option, the creditworthiness of the seller becomes as important as the nature of the product.

Counterparty credit risk has been effectively dealt with for centuries through organized financial exchanges, a type of community that guarantees that contracts will be honored even if one or more of the members defaults. But bilateral over-the-counter trading remained a wild space of sorts, with parties deciding on an ad hoc basis whether the trade should be collateralized or not and what kind of collateral would be acceptable. The more stringent the collateral requirements, the lower the credit risk associated with the transaction. And, it follows, the more valuable (expensive) the option: the right to collect some money if the contract expires in-the-money is worth far

---

1 Forthcoming, *Corporate Finance Review*

2 ESADE Business School
more if the chances of actually getting paid are enhanced. Conversely, uncollateralized options could be worth less: the probability of ever getting paid may now seem reduced. Not requiring margin can lead to option values that seem intuitively quite low, especially and perhaps paradoxically when the option should be worth a lot (when it’s deep in-the-money); when the option’s expected payout is say $5 billion the seller may still be considered good for the money and the option’s fair value may contain little credit component thus mostly reflecting the probability of expiring in-the-money, but if the same option’s expected payout is say $10 billion the seller may not be perceived as able to meet such sum in full and the now more significant credit component can seriously depress the option’s fair value from what it would otherwise have been.

The Berkshire Hathaway case, on which I have delved substantially in previous Corporate Finance Review pieces, provides a very clarifying illustration of all these issues. Berkshire sold sizable amounts of derivatives but, even though essentially all these contracts represented liabilities for the firm, it was allowed to do so in a very uncollateralized fashion. Most of the position required no collateral postings from Berkshire, even though the fair value losses could be substantial if markets moved the wrong way. And though such hurtful movements did eventually take place, Berkshire has only had to post relatively tiny amounts of collateral. Here we focus specifically on the equity index puts part of the sold derivatives portfolio, as it has always been by far the most sizable component (this is especially true today).

The conclusion must be that Berkshire Hathaway won big by being able to trade in a collateral-lite manner. As was mentioned in a previous piece, Berkshire would not have sold those options had it faced less amicable credit support policies. For Berkshire, it is absolutely essential that these contracts not impose potentially hefty (and sudden) demands for liquid assets. While this would be true for many financial players, it is even more so in the case of Berkshire as it would come into direct conflict with the very reason for the trade. Berkshire sold options as a funding mechanism, to raise funds that can be invested freely, not to face the threat of having to commit funds in the future. When you are selling options to generate positive float, anything that can
prevent you from using that float throughout would defeat the very purpose of the undertaking.

But on top of that primal benefit, the lack of collateral afforded Berkshire several other pleasantries. Let’s try to list them:

- **Better sleep quality**: naturally, if collateral won’t be demanded you’ll care that much less about changes in the fair value of the portfolio (no need to excruciatingly sweat that inevitable turbulence with the accompanying potentially very large liabilities numbers, as it won’t translate into large cash demands); that, to say the least, is quite a relief

- **Lower liabilities**: since the absence of collateral would have to be priced into the contract leading to a higher discount factor and thus a lower value for the option than otherwise, option sellers would face lower liabilities than otherwise (and, and this is critical, this is even more the case precisely as the option gets deeper in-the-money: as the amount of money that the option seller would owe appears ever larger, the credit risk of the option seller would be more of a concern, and the credit risk premium thus a larger number)

- **Liabilities hedge**: similar to above, as the market variables lead to increased liabilities (i.e., the option is worth more) the credit factor provides a counterbalance by leading to decreased liabilities (i.e., the option is worth less); perceptions of lower credit quality lead to lower liabilities and thus lower termination costs, so a good compensates for a bad; especially true when needed the most

- **Calculation flexibility**: the need to incorporate a credit risk spread on top of the risk-free benchmark gives more room to “play around” with the interest rate parameter in the option pricing model (in this case, Black-Scholes), thus yielding more arbitrary liability numbers; particularly true here as the puts were classified as Level 3 and so fair-valued on a mark-to-model basis rather than a pure mark-to-market basis as it was assumed that these options are non-
standard and mightily illiquid thus requiring subjective assessments given the lack of ready liquid market references; selecting a larger credit spread is equivalent to inputting a larger number in the interest rate box of the Black-Scholes formula (which is supposed to account just for a default-less risk-free rate), and a larger rate figure leads to lower put option prices.

- **Friendly restructuring:** if the option seller’s liabilities get too out of hand (say, because financial markets collapse or volatility explores or both) the credit risk may become unbearable, and unbearably expensive to hedge, for the option buyer who as a result may be willing to restructure the trade in terms very favourable to the seller so as to drastically reduce that bothersome liability number.

All these things are certainly attractive for an option seller, and may amply make up for the lower premium that was collected upfront. Had Berkshire agreed to margining the puts, thus erasing creditworthiness concerns of the counterparts, it would have obtained a higher value from the sale (and thus a higher float). The firm at the time declared its willingness to accept the trade-off, collateral being such an utterly despised inconvenience.

Introducing credit risk into the picture allows us to provide a plausible explanation for what in previous analyses had been considered a somewhat puzzling development: the apparently low puts portfolio liabilities accounted for by Berkshire in late 2008 and early 2009. Naturally, around those times the position was bleeding badly due to the “unholy trinity” of collapsing stock markets, exploding volatility, and tanking interest rates. For a $35-40 billion notional exposure, one might have intuitively expected a bigger accounting setback than the $10 billion reported. But if we take credit spreads into the equation, it all may make more sense, the above-mentioned liabilities hedge fully at play here. As the options get insufferably deeper in-the-money, Berkshire’s credit risk on these non-collateralized obligations spikes up driving the discount factor upwards and therefore yielding a diminished present-valued future payout and thus a diminished
option price or termination cost. In other words, the very fact that Berkshire’s creditworthiness seems worse makes the trade look better for the firm.

**Let’s Credit**

How should the price of an option be impacted by the introduction of credit risk? The precise impact would depend on the precise nature of the contract and the seller as well as market developments, but let’s borrow from a specific example to at least have some idea. Luckily for us, this example (courtesy of a Goldman Sachs’ November 2012 presentation) happens to closely mimic Berkshire Hathaway’s exposure.

In the presentation, Goldman prices a 10-year, at-the-money, European put option on the S&P 500. As we know, Berkshire had sold long-dated, at-the-money, European put options on the S&P 500. Assuming that the trade was entirely collateralized with cash at a threshold of zero (so margining starts right away at the first sign of mark-to-market loss), the put is worth 29.5% of notional. If we include US corporate bonds in the eligible collateral mix, the price goes down to 29.1%. If we add non-US corporate bonds, a further decline to 27.7%. So the nature of the collateral matters, of course. In any case, those are pretty expensive prices: erasing the credit risk certainly pays.

As an illustration, the Black-Scholes price of an at-the-money, 10-year, 21%-volatility, 1.15%-rates put would be 17.8% (no credit risk included), using same vol and benchmark rates data as used by Berkshire to value its puts liability as of 31 December 2012. From this primitive example, it would appear that the credit risk premium can be indeed significant. If you want to sell an option, committing high quality guarantees can be a pretty good way to maximize the amount of money collected. On the other hand, not making such commitments can significantly cut into your upfront collections.

How about the put buyer? Would it also account for the sellers’ creditworthiness? Here any credit spread leads to lower asset values than otherwise, as expected future cash inflows get a lower present value. Will both buyer and seller mark the trade at the same credit spread? That’s a good question. We know that Lehman Brothers, one of Berkshire’s put counterparts, made up for the lack of credit support annex in the
contracts by discounting at an above-benchmark rate level (in an early 2007 example, Lehman was discounting the put’s cash flows at Libor + 32 basis points, rather than at Libor flat as would have been the case in a margined trade).

What spread did Berkshire use? The firm provides information since year-end 2008:

<table>
<thead>
<tr>
<th>Year</th>
<th>Interest rate (model input)</th>
<th>BH spread</th>
<th>Benchmark rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>4.00%</td>
<td>1.25%</td>
<td>2.75%</td>
</tr>
<tr>
<td>2009</td>
<td>4.00%</td>
<td>0.55%</td>
<td>3.45%</td>
</tr>
<tr>
<td>2010</td>
<td>3.70%</td>
<td>0.82%</td>
<td>2.88%</td>
</tr>
<tr>
<td>2011</td>
<td>3.30%</td>
<td>1.53%</td>
<td>1.77%</td>
</tr>
<tr>
<td>2012</td>
<td>2.10%</td>
<td>0.95%</td>
<td>1.15%</td>
</tr>
</tbody>
</table>

The credit spread is reportedly related to Berkshire’s weighted average cost of funds, reflecting spreads with regards to debt obligations with similar durations and similarly rated. It is not, thus, directly linked to Berkshire’s credit default swap spreads.

However, those CDS prices will have an impact if option buyers are being forced to hedge themselves against the possibility that the option seller will not honour its obligations. If buyers have to purchase credit protection, that adds an extra cost (maybe small, maybe very large) to the whole transaction. In a way, option buyers get penalized because the market moved exactly as they would have hoped. A win may be transformed into a loss, a comfort into a nuisance. That extra cost will get built into the overall discount factor, thus lowering the option’s value, perhaps by a lot, and keeping asset and liability numbers subdued. Even as markets tank, volatilities boom, and interest rates dive, the put may be worth just a tiny extra more for the buyer if the counterparty credit risk adjustment is severe. Another example of the apparently odd link: if you sold options and you now look like a worse credit, your option position may substantially gain in value. The perception that you are a less reliable entity can do wonders for your net income, at least when it comes to the options portfolio’s contribution to overall profits and losses.

The need to hedge via CDS has become more urgent as a result of the financial crisis. Not only have internal risk management departments and credit risk chiefs turned much more vigilant and intolerable of exposures, but regulators are also helping shape things. As a result of post-crisis capital regulations, banks that run uncollateralized
derivatives positions must hedge their counterparty risk or face the wrath of additional capital charges through the menacing and menacingly named credit-valuation-adjustment (CVA) mechanism. Given how little banks enjoy extra capital requirements, traders have a very strong incentive to go into the market and purchase protection, especially when the exposure has become noticeable. CVA thus can lead to a significant increase in derivatives prices.

The correlation between the option’s underlying assets and the seller’s CDS prices (and credit risk in general) becomes important in determining the final liabilities to be faced by the seller. If the credit risk, and cost of hedging it, goes up as the option’s expected payout also goes up then the credit spread built into the discount factor is higher. In Berkshire’s case, the critical correlation would be between international equity indices and its perceived creditworthiness. Equities going down and/or getting volatile plus a deterioration in the firm’s credit risk would be the most relevant combination: if Berkshire seems a shakier (and most costly to protect against) counterparty precisely when it faces a larger obligation, the adjustment to the option’s value could be mighty. This can be compounded given Berkshire’s large investments in cash equities, making the firm’s assets decline just as its liabilities increase. It could be concluded that as equities go down Berkshire’s credit risk premium would go up, benefiting its put position (much lower liabilities than would be expected, at the right time to boot) while hurting the counterparts (much less valuable assets than would be expected). Lower equities would increase the puts intrinsic value but at the same time would indicate that Berkshire may have a harder time meeting those obligations, cushioning the impact on reported results, maybe magnificently so. Whether intentionally or not, Berkshire sold a derivative that contains an in-built accounting edge, and hedge, for the seller.

A CDS Meltdown

In Q4 2008 and Q1 2009 CDS spreads on Berkshire Hathaway exploded to “crazy” levels (see below). Few seemed to be able to explain the purportedly irrational development. Berkshire itself clarified things though. The firm’s derivatives liabilities
(not just the equity puts, but also the credit protection sold on high-yield corporate names and states/municipalities) had skyrocketed so much as the financial crisis fully erupted that the counterparts were forced to hedge the credit risk in force, driving the cost of protection higher. So high in fact that it became prohibitively expensive, just as the need for risk management appeared more urgent. It became more efficient for dealers to amend the terms of some contracts and achieve an immediate and drastic reduction in accounting exposures.

In Q2 2009, Berkshire did just that and modified six put contracts, mostly referenced to the S&P. Maturities were reduced between four and ten years, and strikes were reduced between 29% and 39%. In the specific case of the amended S&P puts, maturities went from 18 to 10 years and strikes from 1500 to 990 (the index was below 900 at the time, so the original strikes were massively in-the-money; the original notional amount of those puts reportedly was $2 billion). All those were extremely favourable changes for Berkshire, as much lower expiration dates and much lower strike prices lead to sharp reductions in the price of a put. Dealers did not charge Berkshire any money for the restructuring, in spite of the extreme gain in value for the firm. The notional on the new contracts was increased by $160 million, but this feels like scant compensation for the dealers which main benefit from the amendment was likely the much reduced hedging costs (a much smaller exposure to hedge now, shorter-dated protection cheaper than longer-dated one). End-Q2 2009 puts liabilities declined to $8.2 billion from $10 billion three months earlier. The new strikes makes it
very unlikely that the S&P puts will expire in-the-money or ever have positive intrinsic value again, especially given the tremendous post-crisis recovery experienced by US stocks (the S&P 500 is currently trading at around 1800). Dealers’ credit concerns have thus been exponentially assuaged, at least when it comes to those contracts. By the way, Berkshire CDS spreads collapsed right after the restructuring and have remained pretty subdued ever since.

Conclusions

- Uncollateralized options can cost less as the expectation of a payout is diminished by the enhanced credit risk; a spread premium is added to the risk free rate leading to a higher discount rate and thus a lower option premium

- Uncollateralized options can also force the buyers to actively hedge the seller’s credit risk in the CDS market, with those extra costs leading to a lower option value/premium

- A loss of creditworthiness (real or perceived) on the part of the option seller can work wonders in terms of reduced liabilities, especially when it matters the most (when the option is deeper in-the-money)

- Renewed post-crisis focus on credit risk by bankers and regulators makes the credit premium more relevant

- Berkshire Hathaway benefited from (mostly) not having to post margin in a variety of ways: its liabilities would now be lower than otherwise, it would enjoy a "liability hedge" from unfriendly market developments, it gained extra flexibility in accounting for the options, and it got a very favourable contracts restructuring

- Given Berkshire’s sizable equities investment portfolio, there can be a very strong correlation between the puts portfolio and the firm’s credit risk, leading to a very significant discount factor premium (the puts value could rise by just a little even as market conditions move heavily in-the-money, a somewhat puzzling scenario for Berkshire’s counterparts)
Black-Scholes overstates option prices because it doesn’t take credit risk into account (probability of default is not included, thus higher expected payout thus higher value); if you eliminate that risk via collateral then the Black-Scholes price may be right; if Berkshire’s counterparties did not adjust for credit risk at the time of the purchase then those unmargined puts would have been effectively sold at a premium