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Group Number: (21/06) Computational Finance (C20-S4) Group 21

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Question 1

What are the advantages and disadvantages of purchasing the up-and-out barrier call option, compared to the plain vanilla European call option?

Ans - An up-and-out option is a kind of a knock-out barrier option that will no longer exist if the underlying security (collateral) price rises above a specific price level which is also known as , the barrier price . On the other hand, In the case of the price of underlying security not going above the barrier level, then, in this case, the option will act like any other vanilla option which means that the option holder has the right but not the obligation to exercise(use) their call option.

Now coming to the advantages, the up-and-out barrier call option requires lower investment than the amount requires to go for a plain vanilla call option. Thus, lower investment signifies smaller loss if the option is not exercised and obviously a greater profit in case of exercising the option. Moreover, these options being over the counter (OTC), they can be customised accordingly.

On the other hand, there are some disadvantages (cons) as well of up-and-out barrier call option and that is, the options trader has to consider both the direction and magnitude of the likely change in the underlying security. A significant bigger movement might result in

the option being knocked out and the loss being incurred of the amount paid in advance in the form of a premium paid. We can also say that the up-and-out barrier call option has some kind of lack of transparency and liquidity to some extent.

Question 2

Would you expect to find this option on an exchange or Over-The-Counter?
Ans- Yes I would like to go for this option because of the low investment it requires and it is very much evident that the up-and-out barrier call option has greater application in currency markets in comparison to equity markets. Lower investment in the up-and-out barrier call option also allows us to be more flexible and control our hedging in a better way.
Q3 - Is there a closed-form, analytical solution for pricing an up-and-out barrier call option?
Ans – yes, there is a closed-form, analytical solution for pricing an up-and-out barrier call option which is risk-neutral valuation. The Monte Carlo approach can be used while the valuation of the up-and-out barrier call option.

Question 10

Write a 1-page non-technical document that explains the difference in the default-free value of the option and the Credit Valuation Adjustment.
Ans – As we know, Credit Valuation Adjustment (CVA) is the price or adjustment that one has to pay or make in order to hedge the portfolio of derivative instruments against counterparty credit risk. In simple terms, CVA is the adjustment to get some kind of security in case the other party defaults. Now it is very much evident that CVA enhances the fair value accounting and is greatly used in derivative market including bonds, receipts and other financial instruments . Credit Valuation Adjustment was first introduced as a requirement of fair value accounting during the world financial crises of 2007/08 which was considered to be the biggest fall in the economic industry denoting the most impacting recession to date. Since then (introduction of CVA in 2007), CVA has attracted so many derivatives market participants and almost every one of them has incorporated CVA in pricing their options because of its long list of pros. CVA came into action because of the increased number of defaults (both country and corporate defaults) and of course financial fallouts. Since it was the time around the world's biggest recession, many large companies collapsed before, during and after the global recession. Before CVA came into existence, large derivative counterparties being getting defaulted was not even a case to be considered and was thought to be too big to ball but after large financial companies being insolvent and defaulting, CVA was the best thing to take default risk as a legitimate scenario. We can then officially say that CVA has made so many pricing deals successful and profitable simultaneously. Coming towards the calculation of CVA, it does not include any specific or unique method of calculation, basically, it depends on different versions as financial institutions use it differently depending on their need and flexibility. So we can say that

there is no standardised methodology for CVA. If in case a complex CVA approach is being used, then it might require market risk factor simulations and different market scenarios in order to get complete ongoing processes in the market. Moreover, until and unless the market scenarios are not being considered, we cannot apply many CVA approaches because of their rigidness and difficult to use mechanism. Because of CVA's diversity and importance at the same time, many financial institutions have a separate CVA trading desk to consider all the ongoing processes and diversifications. Large financial companies that have a high share of derivatives in their portfolio invest heavily in CVA analysis and even have a separate CVA trading desk. On the other hand, the default-free value of an option refers to the price of the option when there is no default risk i.e., the option would not be claimed to exercise. In the case of default-free options, a claim is not made in order to compensate for the loss incurred. A very famous example of the default-free value of the option is the Black Scholes model which is the most common model used for evaluating the options in the market. CVA is basically a change to the market value of derivative instruments for other parties (counter party's) credit risk. This adjustment is made mostly in the case of credit risk which is not the case with default-free options in most of the scenarios. CVA represents the discount to the standard derivative value that a buyer would offer after taking into consideration the possibility of the other party's default whereas the default case is not even an option while considering the default-free bonds as the name suggests. As we already mentioned, CVA is the adjustment made to hedge the counterparty's credit risk related to the derivative instrument and in the case of default-free options, hedging is not even required because of no default possibility. CVA reduces the mark to the market value of an asset by the value of CVA which is being adjusted. For CVA valuation.

Touching the topic of CVA valuation methods we have the following few methods of CVA valuation: -

1) Swaption-type Valuation

It is a kind of complex credit valuation adjustment methodology and requires advance and in-depth knowledge of derivatives and also requires access to specific market data. The important methodology it follows is that it uses the counterparty credit spread in order to estimate the replacement value of the asset,

2) Simple Approach

In this method, the mark to the market value of the instrument is calculated and then is repeated to adjust the discount rates by the counterparty's credit spread. We then calculate the difference between the resulting values obtaining the required CVA.

3) Simulation Modeling

This method involves simulation of market risk factors and other risk factor scenarios, these derivatives are then valued using multiple simulation scenarios (taking every scenario into consideration). Furthermore, the exposure profile is then determined of each counterparty by aggregating the resulting matrix and this expected exposure profile is adjusted to derive the collateralized expected exposure profile.

Below is a small diagram that will make CVA clearer.


Counter Party Credit Risk
Fair Value of Derivative
Cost to Hedge Against
Credit RIsk
Eliminated Risk
Market Value of
Derivative