Case Write-Up 3: First American Bank: Credit Default Swaps

One of Charles Bank International’s (CBI) clients, CapEX Unlimited (CEU), has asked for a new $50 million loan. However, if CBI grants it this loan is exposure to CEU is too large, i.e. the concentration risk exceeds CBI’s internal guidelines. Now, CBI has approached First American Bank (FAB) to see if a credit default swap between FAB and itself can be established, which would mitigate the extra credit risk for CBI from the new loan.

What is a default swap? How does it work?

Generally, credit derivatives are contracts where the payoff depends on the creditworthiness of one or more companies or countries. These contracts allow firms to trade credit risk in similar to the way they trade market risk. Roughly, credit risk can be defined as the risk that borrowers or counterparties (in derivatives transactions) may default. Credit derivatives can be categorized as single-name or multi-name contracts.

A credit default swap (CDS) is a single-name credit derivative contract between two counterparties. It provides insurance against the risk of default (credit risk) by a particular company (the reference entity). The buyer of a CDS, who is taking a short position in the credit event risk, makes periodic payments to the seller of the CDS until expiry of the contract or the company defaults (this is known as a credit event). In return, the buyer receives protection in the form of the right to sell bonds issued by the company for their par value to the seller of the CDS if the company defaults. The notional principal of a CDS is the total face value of the bonds that can be sold in the case of a credit event.

The spread of a CDS is the total amount paid per year to buy protection, expressed as a percentage of the notational principle. If the maturity of two CDSs is equal, then the company with a higher CDS spread is considered to be more likely to default, because a higher fee is charged to receive protection against this company, ceteris paribus.

To illustrate the mechanics, say firm A buys a CDS on firm B from firm C. Return to for the insurance, A would have to pay a periodic fee to C until the CDS expires. However, if B defaults before expiry of the contract, buyer A has the right to sell bonds issued by B for the par value to seller C and the contract is terminated.

If buyer A actually owns bonds issued by B, buying a CDS can be considered a hedge against the credit risk of B. However, investors also buy CDS without owning debt issued by B. Firms may do this for speculative purposes; they bet against the solvency of firm B, making money if it defaults.

The settlement in the event of default involves either physical delivery or a cash payment. In a physical settlement, A delivers defaulted bonds issued by B to C and C pays A the corresponding face value. In a cash settlement, C pays A the difference between the face value and the market value of the underlying bonds.

What would be the fair level for the semi-annual fixed fee on the default swap?

According to Exhibit 10b, the probability that CEU will default by the end of 2 years is 13.7% given CEU’s current B2 credit rating. The probability that CEU will default within 1 year is 6.23%, and the probability that CEU defaults during the second year (given it didn’t default during the first) is 13.7% -
6.23\% \approx 7.47\%. The average yearly default probability for technology firms during 1970-2000 was 1.24 \% (Exhibit 10a).

However, these default probabilities are historical; we should use risk neutral probabilities when valuating credit derivatives. Therefore, we use Merton’s model to derive the risk-neutral probability that CEU will default on its debt.

Currently, CEU’s market value of debt is $4,100 million and its market value of equity equals $6,800 million ($E_0$). This gives a total market value of the firm equal to $10,900 million ($V_0$). The outstanding debt has a maturity of 5 years. Equity can be considered a call option on the firm’s assets with strike price equal to the face value of the debt and expiration equal to the maturity of the debt. In Exhibit 13, we are offered different call options maturing in 2 years (we assume that the present time is January 1, 2002). We assume that the volatility is constant through time, i.e. the implied volatility of a call maturing in 5 years is the same as the implied volatility of a similar call maturing in 2 years. We don’t know the exact face value of the debt, but we know that it must be larger than $4,100 million. The January 4 call options with strike prices of $45.0 and larger are probably those that are closest to the face value of the debt (if scaled up); thus we use 49\% as the volatility of equity ($\sigma_E$).

We know $V_0$, $E_0$, and $\sigma_E$, but we need the face value of the debt ($D$) and the volatility of the firm’s assets ($\sigma_V$) in order to find the default probability. To find these variables, we need to simultaneously solve the following two equations:

\[
E_0 = V_0 \Phi(d_1) - D e^{-rT} \Phi(d_2) \quad \text{and} \quad \sigma_E E_0 = \Phi(d_1) \sigma_V V_0
\]

where

\[
d_1 = \frac{\ln(V_0 / D) + (r + \sigma_V^2 / 2)T}{\sigma_V \sqrt{T}} \quad \text{and} \quad d_2 = d_1 - \sigma_V \sqrt{T}
\]

This can be achieved by solving the following optimization problem with respect to $D$ and $\sigma_V$.

\[
\min_{D,\sigma_V} \quad E_0 - V_0 \Phi(d_1) + D e^{-rT} \Phi(d_2)^2 + \sigma_E E_0 - \Phi(d_1) \sigma_V V_0^2
\]

Using the solver-function in Excel, we get $D = $5412 million and $\sigma_V = 32\%$. Using these values, we can calculate the risk-neutral probability that CEU has defaulted on its debt by the end of 5 years.

\[
p = \Phi(-d_2) \approx 17.7\%
\]

This is a cumulative probability (We realize that this is much lower than expected; we would had expected to be larger than the cumulative historical default probability). Assuming that the probability of default is the same during each six months in the 5 year period, we estimate the probability of defaulting within a 6-months period to 17.7/10 = 1.77\%.
Now, let’s calculated the expected cash flows from the default swap.

The recovery rate on the $50 million bank loan is assumed to be 82% (Exhibit 14).

We are valuing the CDS in the risk-neutral world, i.e. we are using risk-neutral default probabilities. Naturally, when we use risk-neutral valuation, we should use the risk-free interest rate to discount the future expected cash flows. We use 4.5 % (p. 3) as risk-free interest rate.

Fee payments on the swap are made at rate $s$ semi-annually. Also, we assume that defaults always happen semi-annually.

In the following calculations we assumed a notational principal of $1.

<table>
<thead>
<tr>
<th>Time</th>
<th>Default Probability</th>
<th>Survival Probability</th>
<th>Expected Cost at Default</th>
<th>Expected Fee Payment</th>
<th>Discount Factors (continuous compounding)</th>
<th>PV (Expected Cost)</th>
<th>PV(Expected Fee Payment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6M</td>
<td>0.0177</td>
<td>0.9823</td>
<td>0.003186</td>
<td>0.9823</td>
<td>0.9678</td>
<td>0.003115</td>
<td>0.9605r</td>
</tr>
<tr>
<td>12M</td>
<td>0.0177</td>
<td>0.9646</td>
<td>0.003186</td>
<td>0.9646</td>
<td>0.9560</td>
<td>0.003046</td>
<td>0.9222r</td>
</tr>
<tr>
<td>18M</td>
<td>0.0177</td>
<td>0.9469</td>
<td>0.003186</td>
<td>0.9469</td>
<td>0.9347</td>
<td>0.002978</td>
<td>0.8851r</td>
</tr>
<tr>
<td>24M</td>
<td>0.0177</td>
<td>0.9292</td>
<td>0.003186</td>
<td>0.9292</td>
<td>0.9139</td>
<td>0.002912</td>
<td>0.8492r</td>
</tr>
</tbody>
</table>

Total PV of Expected Costs = 0.012051
Total PV of Expected Fee Payments = 3.617r

Setting these equal and solving for $s$, we get $s = 0.00333$, which is the semiannual fee payment on a default swap with a notational principal of $1.

In our case, the notational principal is $50 million, which means that the fair level of the semi-annual fixed fee is

$$\text{Semiannual fee} = 0.00333 \times 50,000,000 = 166,588$$

Thus, the present value of the total expected costs and the present values of the total expected fee payments are both $602,550 for this semiannual fee level. This gives the following expected cash flow profile of the default swap:

<table>
<thead>
<tr>
<th>Time</th>
<th>Expected Cost at Default</th>
<th>Expected Fee Payment</th>
<th>Discount Factors (continuous compounding)</th>
<th>PV (Expected Cost)</th>
<th>PV(Expected Fee Payment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6M</td>
<td>159,300</td>
<td>163,639.4</td>
<td>0.9778</td>
<td>155,750</td>
<td>160,007.8</td>
</tr>
<tr>
<td>12M</td>
<td>159,300</td>
<td>160,690.8</td>
<td>0.9560</td>
<td>152,300</td>
<td>153,627.5</td>
</tr>
<tr>
<td>18M</td>
<td>159,300</td>
<td>157,742.2</td>
<td>0.9347</td>
<td>148,900</td>
<td>147,447.0</td>
</tr>
<tr>
<td>24M</td>
<td>159,300</td>
<td>154,793.6</td>
<td>0.9139</td>
<td>145,600</td>
<td>141,499.5</td>
</tr>
</tbody>
</table>
Should FAB hold on to the credit risk of CEU? How should Kittal transfer this credit risk from FAB’s balance sheet?

Whether FAB should keep the credit risk or sell it off will especially depend on its \textit{risk tolerance} and the \textit{risk-adjusted return} from keeping the credit risk versus passing it on.

If FAB passes on the credit risk and acts as an intermediary, it would earn a fee on the transaction. If FAB keeps the credit risk, it would earn a semiannual fee on the swap for the 2-year period, corresponding to the amount calculated in the previous question. In addition, FAB would have to put aside enough capital to absorb the new risk. The amount of capital that needs to be put aside depends on its risk tolerance, i.e. the more risk adverse FAB is, the more capital it would want to put aside.

Generally, if the risk-adjusted return – i.e. return adjusted for the amount of capital put aside – that can earned from keeping the credit risk is larger than the return FAB would get if it passed on the risk, it would make sense to keep the credit risk in house, and vice versa.

If FAB chooses not to keep the credit risk, it could pass it on to two relatively low-rated banks and a hedge fund. One way that FAB can pass on the credit risk to the banks and the hedge fund is by entering a credit default swap with them. However, the low credit rating of the protection sellers means that they might default before the expiration of the contract, resulting in them not being able to fulfill their obligations in accordance with the contract if CEU gets into trouble. A CDS is an \textit{unfunded} contract, i.e. no money changes hand at the initiation. Thus, to protect itself against the high counterparty risk, FAB would have to require the protection sellers to provide large amounts of collateral. As a result, the protection sellers would have to tie up capital, on which they would only earn a low return. Consequently, the default swap solution is not attractive for the potential ‘credit risk’-investors.

Instead, FAB will have to find a funded solution, which will prove more attractive to the potential investors. One solution is to issue a credit-linked note (CLN). A CLN is a funded credit derivative, structured as a security with an embedded credit default swap. In our case, this structure would allow FAB (as issuer) to transfer its credit to the investors in the note. By selling a CLN, FAB receives money up front, i.e. it is funded. During the life of the contract, FAB passes on the semiannual fees it receives on the CDS to the investors in the CLN in the form of a higher yield. However, if CEU defaults, FAB is not obligated to repay the notes in full.

This solution seems to be the most attractive for FAB. It is funded which mitigate the counterparty risk that was present in the unfunded default swap solution. In addition, the solution is more attractive to credit-investors. They don’t have to tie up capital as collateral with low returns. Even though they have to pay money up front, they get a high yield on their capital invested as compensation for carrying the credit risk. Thus, if the yield on the notes is high enough, credit investors will find this solution attractive.

In conclusion, if FAB chooses to pass on the credit risk, it should use a funded CLN-strategy.