
Chapter17

Types of Credit Structure

Terminologies

- Credit Structure or Credit Facility
 - An agreement between a bank and a customer that creates credit exposure
 - EAD (Exposure at Default) or LEQ (Loan Equivalence)
 - The outstanding amount at the time of default
 - LIED (Loss in the Event of Default) or LGD (Loss Given Default) or S (Severity)
 - $$\text{LIED} = \frac{\text{EAD} + \text{Admin} - \text{Recoveries}}{\text{EAD}}$$
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- PD (Probability of Default) or EDF (Expected Default Frequency) or Default Rate
 - The EAD and LIED are strongly influenced by the type of credit structure

For Company Customers

- Credit exposures to large corporations
 - Commercial loans
 - ◆ Secured vs. Unsecured (有無collateral)
 - ◆ Collateral: traded securities, inventories, buildings, the rights to a stream of cash flows
 - ◆ Unsecured loan: Senior vs. Subordinated (junior)
 - ◆ Credit-risk measurement for loans: collateral type, the level of seniority, the maturity, and the scheduled cash flow
 - ◆ Syndicated loan (增加secondary trading的可能)

- Commercial lines

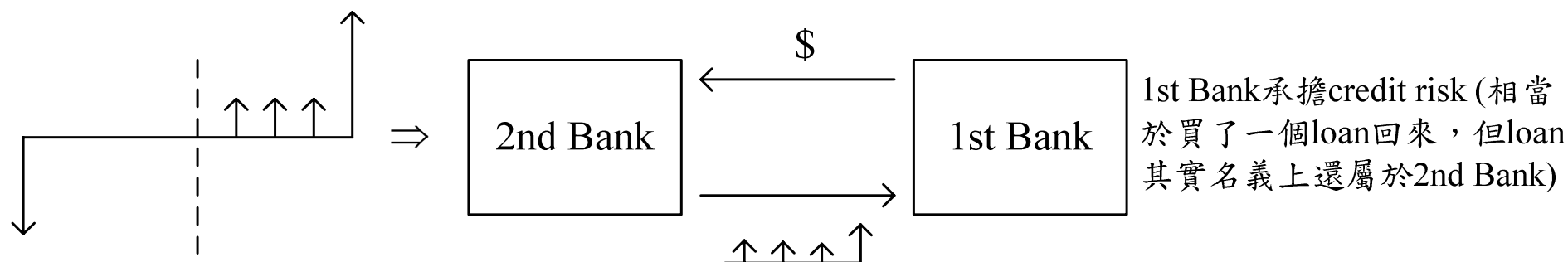
- ◆ A line of credit is also known as a revolver or a commitment
- ◆ Historical studies show that companies going into default tend to draw down more than healthy companies
- ◆ Three models used for the EAD of a line of credit
 - $EAD = A \times \text{Drawn Amount}$, $A \geq 1$
 - $EAD = B \times \text{Line}$, $1 \geq B \geq 0$
 - $EAD = \text{Drawn Amount} + C \times (\text{Line} - \text{Drawn Amount})$, $1 \geq C \geq 0$
- ◆ The bank charges the company one rate of interest (cost of debt + cost of capital) for the drawn portion and another lower rate of interest (cost of capital) for the additional amount that the bank has committed to lend

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- Letters of credit and guarantees
 - ◆ Trade LCs (for importer) vs. Backup LCs (for credit enhancement)
 - ◆ The credit risk of backup LCs is considered as a full loan, and the customer is charged for the economic capital the bank set aside in case the customer defaults
 - Leases
 - ◆ Leases are a form of collateralized loan
 - ◆ In terms of credit risk, lease is equivalent to giving the customer a loan, having them buy the equipment, and pledging the equipment as collateral to secure the loan
 - ◆ The bank may or may not have a further claim on the company if the value of the equipment is less than the amount of the loan
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■ Credit derivatives

- ◆ They are designed so their values are determined by credit events, such as a default or a down-grade
- ◆ Credit derivatives的用處
 - It is easy to transfer credit risk without transferring the ownership of a loan
 - 容許部份credit risk轉移 (例如只轉移default risk，而不考慮down-grade risk)
 - 可只針對某種credit risk (credit event)設計

- ◆ Type1: total return swap (all the credit risk is transferred)
(很像equity swap，可以很容易的轉移債權)



★ 此類credit derivatives，很常發生在一邊想直接買而不可得，另一邊想直接賣也不可得之情況下

- ◆ Type2: if the corporation defaults, the credit buyer pays a fixed amount to the credit seller and the contract terminates (很像insurance) (In such contract, however, there is the possibility of the bank making a loss or profit if the actual LIED is different from the derivative payment)

For Retail Customers

- Credit exposure to retail customers
 - Personal loans
 - ◆ They are typically unsecured
 - ◆ They are generally amortizing loans
 - Credit cards
 - ◆ The interest-rate is 10%~15% above the floating prime rate
 - Car loans
 - ◆ Similar to personal loans, except they are for a specific purpose and have the car as collateral
 - Mortgages
 - ◆ Loan-to-value (LTV) is set to be less a level, i.e. 80%
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- Leases and Hire-purchase agreements
 - ◆ For leases, the customer makes regular payments to cover the interest and the depreciation, and has the option to buy the asset at the end of the lease
 - ◆ Hire-purchase agreements are similar to leases except that the payments include the full value of the asset
 - ◆ These agreements are similar to car loans in that they are secured by the physical asset owned by the bank until finishing all lease payments
 - Home-equity lines of credit (HELOC)
 - ◆ A HELOC is like a credit card but secured by the customer's house
 - ◆ This ensures a low probability of default
 - ◆ HELOCs are generally subordinated to the customer's primary mortgage
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- In summary about the retail customers
 - ◆ Loans to retail customers are relatively small
 - ◆ The terms of the agreements between a bank and its customer are much more standardized
 - ◆ Only a small amount of information is known about each customer, but the average behavior of a large number of customers can be predicted well by analyzing the historical data
 - FICO score model by Fair Isaac Corporation
 - ◆ Input: age, income, total number of cards, number of delinquencies in the last three years
 - ◆ Output: score for a retail customer on probability of default, probability of delinquency, or probability of the customer's actually using a credit card
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- ◆ 一般對於640分以下的放款，稱為subprime

For Counterparties of Trading Operations

- Credit exposures in trading operations
 - Bonds
 - ◆ Changes in value due to the interest rates and spread for a given rating are treated as market risks
 - ◆ Changes in value due to the downgrade and actual default are treated as credit risks (一般來說，downgrade的損失小，所以credit risks大多是指真正違約時的損失)
 - ◆ 因為在快要破產前，bonds的流動性差，使得此時的bonds很像loans，同時，bonds的credit risk也和loan很像，與其seniority與是否有collateral有關

For Counterparties of Trading Operations

■ Asset-backed securities

- ◆ Illustration of an Asset-backed security in Figure 17-1
- ◆ The probability of underpayment depends on the seniority of the tranche, the degree of overcollateralization, and the volatility of the value of the assets
- ◆ 如果銀行順利賣出證券化資產，則不需為此部分準備 regulatory capital，但若賣出的都是評等高的債券，自己留下評等低的債券，則EC其實不該減少很多
- ◆ 在上述情況下，若投資人只看到regulatory capital，而非EC，則會誤以為此銀行很安全，而讓銀行得到很便宜的資金，但銀行卻是從事高風險，(希望)高報酬的投資
- ◆ 計算ABS之credit risk與分析一個portfolio of loan一樣，要先估計收入之機率分配，此部份與個別資產的風險與資產間的相關性有關，然後再看是否足夠支付ABS債券

■ Securities lending and Repurchase Agreements

- ◆ From a credit-risk perspective, both securities lending and repurchase agreements (repos) are short-term collateralized loans
- ◆ For securities lending, the collateral is typically cash
- ◆ Reops: 銀行用證券去換錢，保證之後額外多付一些錢買回
- ◆ Credit risk何時發生
 - Counterparty defaults
 - 借出的證券價值上升，且高於現金抵押或銀行準備付出拿回證券的錢
 - P.240 Figure 17-2 (假設counterparty risk與security value無關)

$$\text{Average Exposure} = \int_0^{\infty} \max[0, V - C] pr(V) dV$$

$$= \int_C^{\infty} (V - C) pr(V) dV$$

■ Margin accounts

- ◆ A margin account is another form of collateralized loan
- ◆ In a margin account, a customer takes a loan from the bank, and then with the loan and his own funds, purchases a security, which is held by the bank as collateral against the loan.
- ◆ Typically, retail customers are allowed to borrow only up to 50% of the value of the securities they own.
- ◆ Margin call: if the value of the securities falls, the bank will ask the customer for more cash to maintain the 50% ratio.
- ◆ Current value of the security is V_0 and of the loan is $V_0 / 2$

$$\text{Average Exposure} = \int_0^{V_0/2} \left(\frac{V_0}{2} - V \right) pr(V) dV$$

■ Credit exposure to derivatives

- ◆ 當衍生性商品對銀行而言是in the money，亦即對counterparty是out of the money，此時對銀行而言，才有default risk
- ◆ The current mark-to-market exposure is a good measurement of the credit exposures of trading counterparties
- ◆ For Vanilla Options
 - There is no credit exposure in the case of shorting option
 - For investing calls, t 天後的maximum likely exposure (MLE) 與 expected exposure (EE) (p.244 Figure 17-4, p.245 the term structure of MLE and EE)

$$\begin{aligned}MLE_t &= C(S_{t,95\%}, T - t) \\ &= C(E[S_t] + 1.64\sqrt{t}\sigma_S, T - t)\end{aligned}$$

$$EE_t = \int_0^{\infty} C(S_t, T - t) pr(S_t) dS_t = E[(C(S_t, T - t))]$$

◆ For FX Swaps

- Considering a FX swap, paying D dollars and receiving P pounds, its value today is

$$V_0 = \left[FX_{P,D} \frac{P}{(1+r_{P,T})^T} \right] - \left[\frac{D}{(1+r_{D,T})^T} \right]$$

- Current credit exposure = $\max[0, V_0]$
- t 天後的MLE and EE

$$MLE_t = \max(0, E[V_t] + 1.64\sigma_V \sqrt{t})$$

$$EE_t = \int_{-\infty}^{\infty} \max(0, V_t) pr(V_t) dV_t$$

- 其實無論是 vanilla option 或是 FX swap，對於隨機變數與其分配的假設都不符合真實的狀況，正確的做法應是把 r_S , r_P , r_D 當作隨機變數，並對其分配做假設

◆ For Interest-Rate Swaps

- Considering an interest-rate swap, receiving fixed rate every six months and paying six-month LIBOR rate, its value today is

$$V_{swap,0} = NPV_{fixed} - NPV_{floating}$$
$$= \left[\sum_{t=T_{next}}^{T_{final}} \frac{Nr_{fix}}{(1+r_t)^t} + \frac{N}{(1+r_{T_{final}})^{T_{final}}} \right] - \left[\frac{Nr_{float}}{(1+r_{T_{next}})^{T_{next}}} + \frac{N}{(1+r_{T_{next}})^{T_{next}}} \right]$$

- Current credit exposure = $\max(0, V_{swap,0})$
- 因為利率的變動比較複雜，再加上會有多次的現金交換， t 天後的MLE and EE for interest-rate swaps，沒有辦法用一個積分來表示
- 考慮模擬interest rate path，來得到 t 天後可能的swap value，並依此swap value的distribution，可估計出MLE與EE之term structure (p.247~248)

■ Mitigating credit risk when trading derivatives

◆ Requiring collateral

- 當銀行手中的derivative是in-the-money，要求至少等值的抵押品，若是out-of-the-money，則不用
- 若衍生性商品合約或抵押品非常volatile (例如抵押品是股票而非現金)，則可能要求高於合約現值一些的抵押品

◆ Settling according to the mark-to-market

- 很像cash collateral，但對雙方都有保障，亦即當對銀行不利時，銀行也要付cash collateral給交易對手
- 諷刺的是，若採用每日結算，雖然可以減少credit risk，則反而會造成交易對手的現金流量更volatile，若交易對手的現金管理不好，反而會增加破產機率

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- ◆ Early settlement in the event of a downgrade
 - 與交易對手的合約中明定，若被downgrade，則立即清算。此條件對於交易對手很不好，因若它被downgrade，還要花一大筆錢來結束合約 (但這必須請信評機構在downgrade前就先通知銀行)
 - ◆ Using a special-purpose vehicle (SPV)
 - Derivative traders want to concentrate on market risks and generally do not want to be distracted by the credit risks
 - 讓交易對手設立一legal separate，且AAA-rating之entity (SPV) 來處理此交易，當交易手破產時，其債權人對此SPV並無求償權，如此一來此交易之credit exposure下降

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- ◆ A netting master agreement (NMA)
 - It is a legal agreement that covers all the derivatives transactions between two institutions
 - 交易雙方可能有多個衍生性商品的交易，若有一方default，則只要依mark-to-market清算net amount即可
 - 若雙方有此合約，會使得對此交易對手的credit exposure的估計變的困難，因為其實credit exposure與雙方交易的衍生性金融商品間的correlation有關，所以通常除了考慮net mark-to-market的exposure，還要加上不考慮NMA時exposure的某個比例
 - ◆ Counterparty exposure limits
 - 接受交易對手有可能default造成損失，但限制在能接受之範圍內
 - The limits have a term structure to limit the exposure at each point in the future (p.252 Figures 17-9, 17-10)
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◆ Pricing for credit risk

- 算出每個衍生性金融商品所需之EC，並將取得此EC之成本加到衍生性商品的價格上，例如，改變swap rate
- A simplified approach是將衍生性商品分為market-risk相關的部份與一個與credit exposure相同的loan，然後對此loan，charge與交易對手之債信相當的credit spread