Counterparty Risk Management and Application of CVA

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The Purpose of Today's Workshop

- In recent years, it seems that globally active banks from the US and the Euro area are establishing to utilize CVA for pricing and risk management.

- The recent financial crisis gave rise to materialization of counterparty credit risk where losses among banks differed as a result of differences in the application of CVA. This triggered the Basel Committee to propose the strengthening of counterparty capital requirements.

- In Japan, CVA is not yet common for counterparty risk management .

- From observing useful collateral management in mitigating counterparty risk, Japan's practice is distinct from the US and the Euro area with regards to categories of eligible collateral, frequency of collateral settlement, and minimum transfer amounts of collateral.
  - —— This may be due to the fact that no defaults from interbank derivative transactions occurred domestically in Japan.

- The purpose of the Workshop is to stimulate discussions on 1) What is CVA? , 2) Meanings and Benefits of adopting CVA, and 3) Practices of Banks from the US and the Euro area, with experts from abroad and foreign banks, and to enhance further understanding of counterparty risk management and CVA.

Today's Agenda

- **What is Counterparty Credit Risk（CCR）?**
- **History and Lessons When CCR Materialized**
- **Methodology of CCR Management**
- **Advantages and Drawbacks in Utilizing CVA**
- **Discussions and Developments in Regulations**

What is Counterparty Credit Risk (CCR)?

What is CCR?

- **Distinct features of spot transaction and derivative transaction from a counterparty credit risk (CCR) perspective.**

Spot transaction	After sales, only Buyer will be affected by underlying asset price changes.
Derivative transaction	After sates, both Seller and Buyer will be affected by underlying asset price changes.

- **Loss events under consideration**
  - **When contracting party in derivatives goes bankrupt before maturity, and contracted payment is not executed.**

    (Notes)   CCR is symmetric between Seller and Buyer. In case when loan repayment is delayed (asymmetric), it is classified as "issuer risk", not CCR.

No default	Contracted payment will be executed until maturity.
Default of Bank	Derivative contract will be cleared off by market price at the time of default. If bank has payment obligation to a counterpart (CP), CP will collect debts (CP will suffer losses, and bank will call for a default). If CP has payment obligation to bank, then CP will execute payment.
Default of Counterparty	Derivative contract will be cleared off by market price at the time of default. If CP has payment obligation to bank, then bank will execute payment (bank will suffer losses, and CP will call for a default). If bank has payment obligation to CP , then bank will execute payment.

- **CCR is variation of the total value of portfolio stemmed from the possibility of defaults of counterparts in derivatives.**

CCR and CVA

- **Default events under consideration**
  - **CP's default**
  - **Bank's own default**
- **Using the price of CCR free derivative（p）, the price of derivative considering CCR（P）can be expressed as below.**

$$P = p + （\text{advantages in values taking account of possibility of bank's own default}）$$
$$- （\text{drawbacks in values taking account of possibility of CP's default}）$$

- **Credit Valuation Adjustment（CVA）is "P-p". CVA is equal to the adjustment term obtained by calculating the price of derivative considering CCR from the price of CCR free derivative.**

  —— **The direction of discussion in the mark-to-market accounting is that the value of derivative contract should contain effect of considering CCR.**

  —— **In the Consultative proposals by the Basel Committee (Dec. 17, 2009), "advantages in values taking account of possibility of bank's own default" term in the above equation is set as zero.**
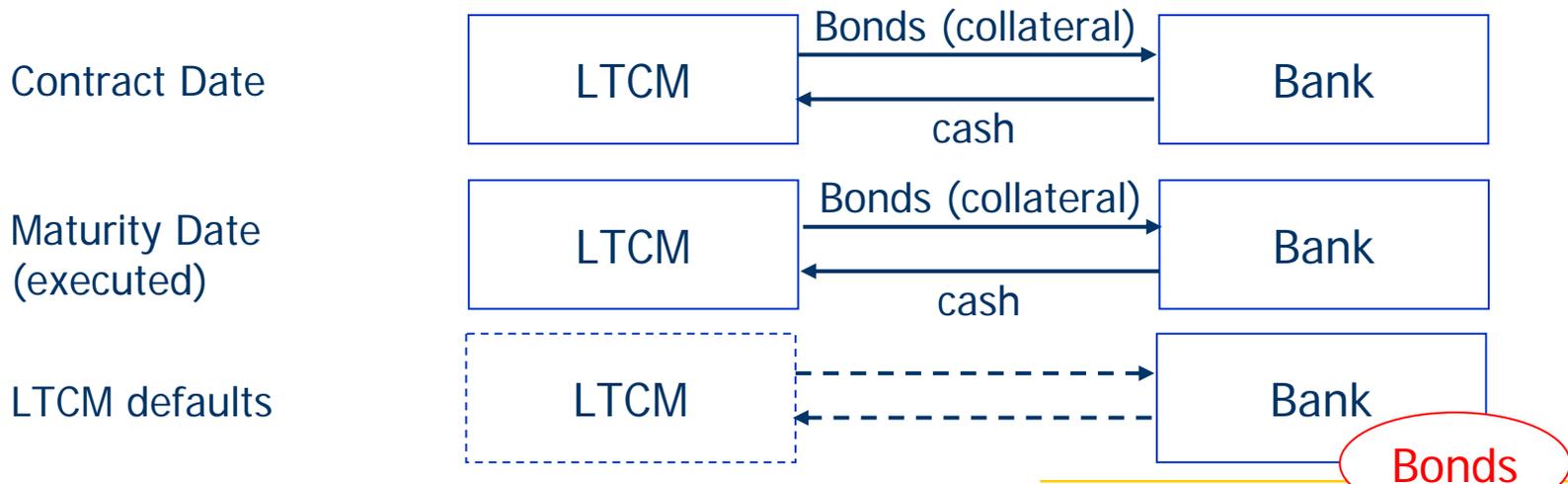
Constituents of CVA

- "Advantages/drawbacks in values taking account of possibility of bank's/CP's default" is the present value of unexecuted contract's cash flows.
- Given that CP defaults in a future time (t),
  - If present value of cash flows after (t) is positive, then CP will go into a default which will cause losses.
  - If present value of cash flows after (t) is negative, then payment obligation will not be reduced, thus loss amount is not changed.
  - ⇒ In a CP's default, there is a mark-to-market loss（drawbacks in values）
  - ⇒ In a bank's own default, there is a mark-to-market gain (advantages in values)

- The amount of losses depends upon the present value at time (t).
- In a likely default environment, advantages and drawbacks may be easier to arise.

- The scale of CVA depends on 1) discounted present value of future derivative price, 2) bank's own creditworthiness, 3) CP's creditworthiness.

History and Lessons When CCR Materialized

Case I - LTCM

- **Failure of LTCM (1998)**
  - **In the bond market, LTCM mainly engaged in relative value trading.**
  - **Further, LTCM took high leverage by using acquired bonds into repo.**
  - ⇒ **This trading strategy under descending bond prices lead to losses which provoked LTCM's fund shortage.**
  - ⇒⇒ **Investment banks were exposed to risks of losing invested funds through repo transaction.**

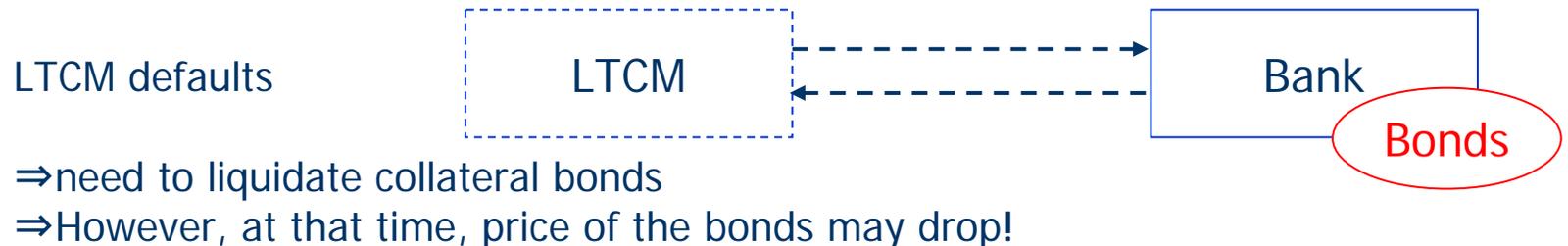|		Bonds (collateral)	
Contract Date	LTCM	→	Bank
		← cash	
		Bonds (collateral)	
Maturity Date (executed)	LTCM	→	Bank
		← cash	
LTCM defaults	LTCM	- - - →	Bank
		← - - -	Bonds

⇒need to liquidate collateral bonds
⇒However, at that time, price of the bonds may drop!

Case I - LTCM

- **Bond prices may change. Thus, when LTCM failed collaterals should be liquidated, and funds should be collected.**
- **To mitigate CCR of LTCM, bank needed to consider bond price changes, and should have provided funds under the upper limit, obtained by subtracting a certain amount (haircuts) from bond price.**
- **At that time, LTCM was able to trade under favorable conditions neglecting these risks, which was backed by their high performances.**

LTCM defaults

| LTCM | ⟷ | Bank |

Bonds

⇒need to liquidate collateral bonds
⇒However, at that time, price of the bonds may drop!

Case I - LTCM

Lessons：

● **CCR exists even in high creditworthy CP, and the amount of CCR may increase enormously.**

⇒ A need for quantitative analysis

● **There is a legal ambiguity in the procedure of disposing collateral bonds.**

⇒ Standardization of collateral treatment（ISDA master agreement）

Case II - Lehman Brothers

Failure of Lehman Brothers (2008)

- **Quantitative analysis of CCR is already conducted among major banks in the US and the Euro area.**

  ⇒ **Huge losses from Lehman Brothers as a counterpart have not been directly derived on the part of banks.**

- **A series of counterparty failures have been observed**

  1. **Banks which did not consider CCR with MtM, suffered an unexpected huge loss**

  2. **Banks which did consider CCR with MtM but did not hedge, suffered a huge loss, as well**

  3. **Banks which did consider CCR with MtM and hedge, suffered a limited amount of loss**

  ⇒ **Mark-to-market losses due to CVA seem to have been two-thirds of total CCR losses (one-thirds were due to actual defaults)**

Case II - Lehman Brothers

Lessons:

- **CCR exists even in high creditworthy CP, and the amount of CCR may increase enormously.**

  ⇒ **A need for quantitative analysis**

- **There is a legal ambiguity in the procedure of disposing collateral bonds.**

  ⇒ **Standardization of collateral treatment (ISDA master agreement)**

- **Marking to market of CCR and hedging are necessary.**

Methodology of CCR Management

Methodology of CCR management

- **Methodology of CCR management consists of (1)mitigation of CCR, (2)valuation and hedging of CCR**

1. Mitigation of CCR

1-1 Netting

➢ **ISDA Master Agreement**

➢ **Utilization of Central Clearing Party (CCP)**

1-2 Collateral management

➢ **ISDA：CSA（Credit Support Annex）**

➢ **Setting appropriate threshold levels, minimum transfer amounts, collateral eligibility criteria, haircuts, independent collateral, etc.**

1-3 Introducing triggers and/or covenants

Methodology of CCR management

**2. Valuation and hedging of CCR**

2-1 Valuation of CCR

- ➢ **Current exposure (CE)**
- ➢ **Potential future exposure (PFE)**

2-2 Hedging CCR

- ➢ **Credit Valuation Adjustment (CVA)**
  - ➢ **Delta hedge of creditworthiness**
  - ➢ **Delta hedge of underlying assets (interest rate, FX etc.)**
  - ➢ **Cross gamma hedge (simultaneous change of creditworthiness and underlying asset prices)**

Valuation of CCR

- **Current Exposure (CE)**
  - ➢ **MtM (Mark to Market) value of contract or portfolio**
  - ➢ **Replacement cost**
- **Potential Future Exposure (PFE)**
  - ➢ **Expected maximum MtM value of contract or portfolio at any future time up to maturity.**
  - ➢ **Maximum value is defined as a percentile to a certain confidence level**
- **CE or PFE is calculated on every CP so that CCR could contain netting effects and collateral agreements.**
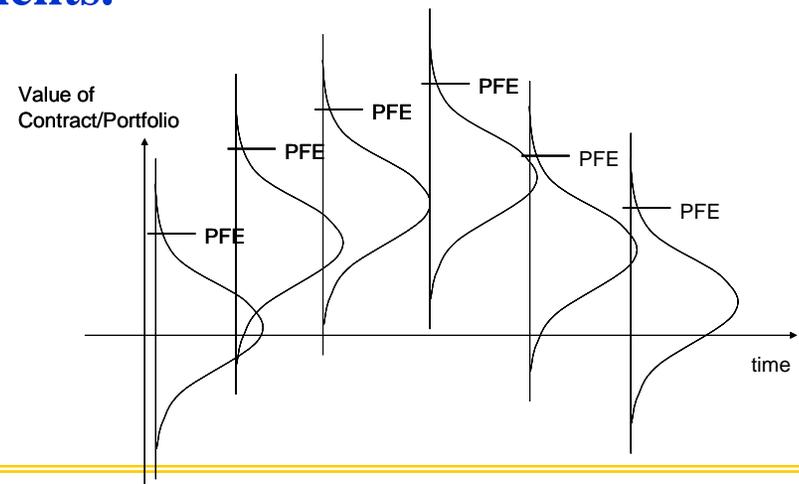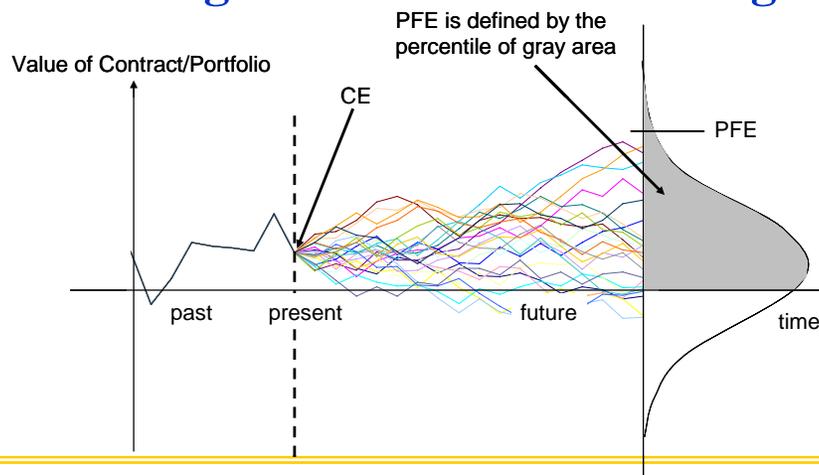
Hedging CCR and CVA

- **Hedging CCR is defined as mitigating CCR of contract or portfolio with other financial transactions**
- **In hedging CCR, MtM value calculation is necessary considering the possibility of CCR materialization.**
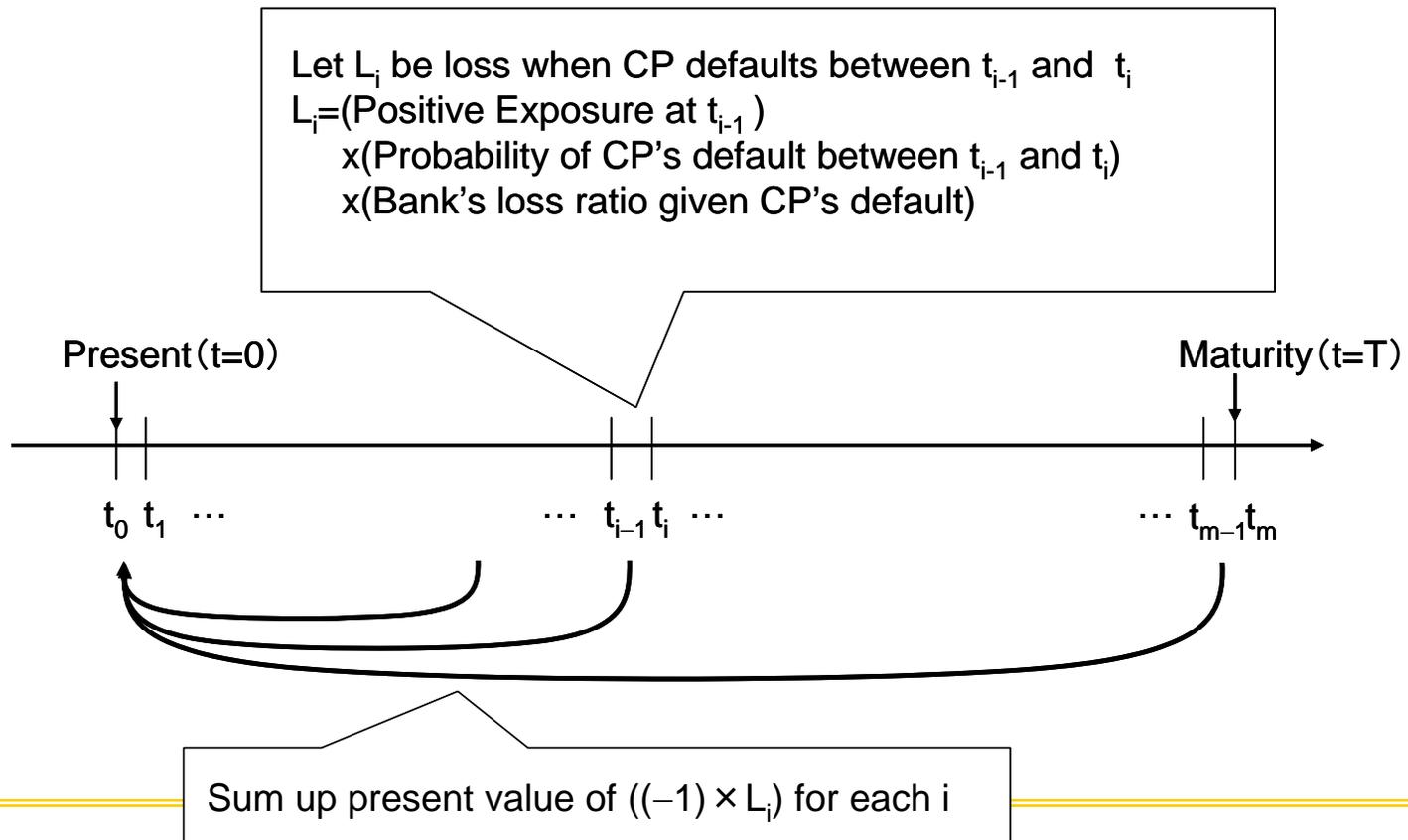- **CVA is MtM value of possibility of materialization of CCR**

CVA is the result of subtracting CCR free price (or portfolio value) from the price (or portfolio value) considering CCR

➢ **Unilateral CVA (shown later) is based on possibility of CP's default only**
➢ **Bilateral CVA (shown later) is based on possibility of both Bank and CP's default**

Hedging CCR is defined as buying and selling other financial instruments which offsets the variation of quantified CVA

Unilateral CVA

- **Figure depicts calculation of unilateral CVA**
- **Unilateral CVA takes negative value**

Let L_i be loss when CP defaults between t_{i-1} and t_i
L_i=(Positive Exposure at t_{i-1})
  x(Probability of CP's default between t_{i-1} and t_i)
  x(Bank's loss ratio given CP's default)

Present（t=0）　　　　　　　　　　　　　　　　　Maturity（t=T）

t_0 t_1 $\cdots$　　　　$\cdots$ t_{i-1} t_i $\cdots$　　　$\cdots$ t_{m-1} t_m

Sum up present value of $((-1) \times L_i)$ for each i

Bilateral CVA

- **Bilateral CVA is the sum of unilateral CVA and MtM of possible loss on Bnak's own default**
- **Bilateral CVA depends on MtMs of possible losses on both Bnak's own default and CP's default. It may take positive or negative numbers**

Let G_i be gain when Bank defaults between t_{i-1} and t_i
Let L_i be loss when CP defaults between t_{i-1} and t_i
G_i=(Negative exposure at t_{i-1})
    x(Probability of Bank's default between t_{i-1} and t_i)
    x(CP's loss ratio given Bank's default)
L_i=(Positive Exposure at t_{i-1})
    x(Probability of CP's default between t_{i-1} and t_i)
    x(Bank's loss ratio given CP's default)

Present（t=0）

Maturity（t=T）

t_0 t_1 …　　　　… t_{i-1} t_i …　　　　… t_{m-1} t_m
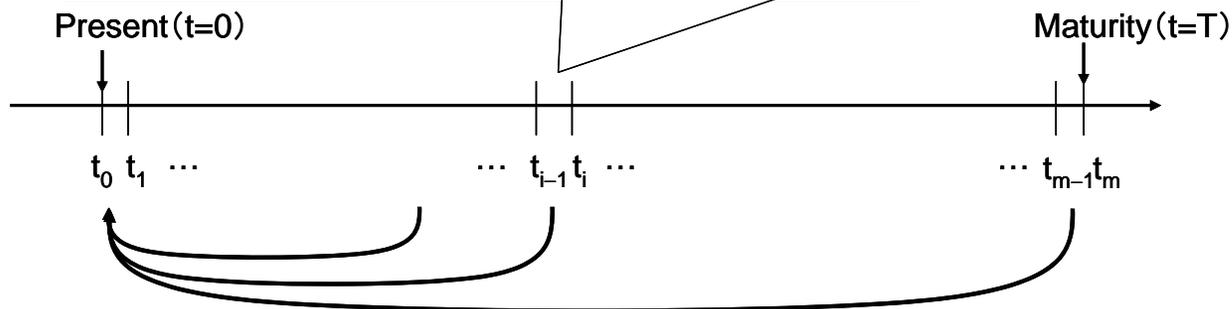
Sum up present value of $((-1) \times G_i + (-1) \times L_i)$ for each i

Hedging CCR by CVA

- **Hedging CCR becomes practicable with calculation of CVA change.**
  - **Delta hedge (creditworthiness)**
  - **Delta hedge (underlying assets)**
  - **Cross gamma hedge**
- **It is very difficult to hedge correlation between creditworthiness and underlying asset prices. Using a theoretical model with the correlation parameter between them, dynamic hedging could mimic some extent of cross gamma hedge.**
- **Examples of the situation in which correlation between creditworthiness and underlying asset prices exist: wrong-way risk etc.**
- **Consideration of netting and/or collateral is necessary for CVA calculation**
  - ⇒ **There exist practical challenges, as well.**

Advantages and Drawbacks in Utilizing CVA

CVA and Adverse Selection

- **Sign(+/-) of bilateral CVA depends on mutual relationship between Bank's and CP's creditworthiness.**
  - **Case I: Bank's creditworthiness is higher than CP's**
    - **Contribution to CVA**

      Bank   CP

      Since Bank's creditworthiness is higher,
      under the condition that exposure and LGD are exactly the same,
   possibility of Bank's default has smaller effect on CVA

    - **Sign of CVA is minus with the same exposure and LGD (CCR free price is higher than price considering the CCR)**
  - **Case II: Bank's credit worthiness is higher than CP's**
    - **Contribution to CVA**

      CP   Bank

      Since Bank's creditworthiness is lower,
      under the condition that exposure and LGD are exactly the same,
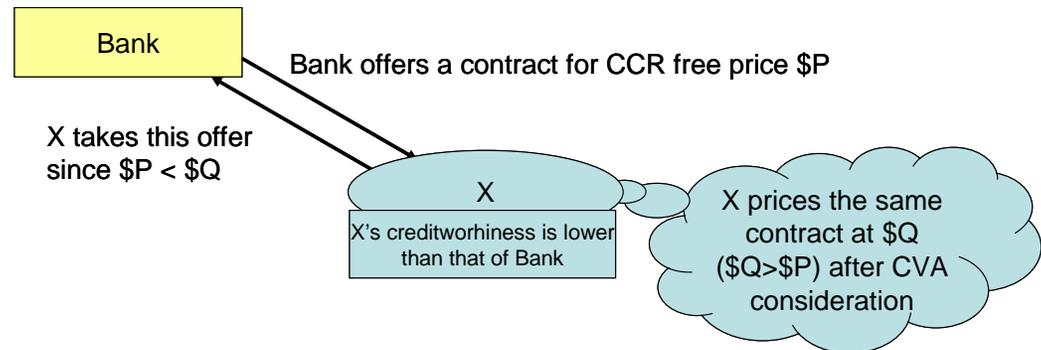   possibility of Bank's default has larger effect on CVA
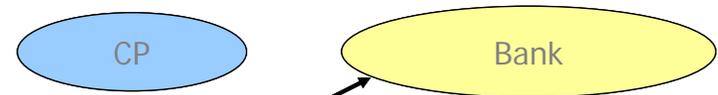
    - **Sign of CVA is plus with the same exposure and LGD (CCR free price is lower than price considering the CCR)**
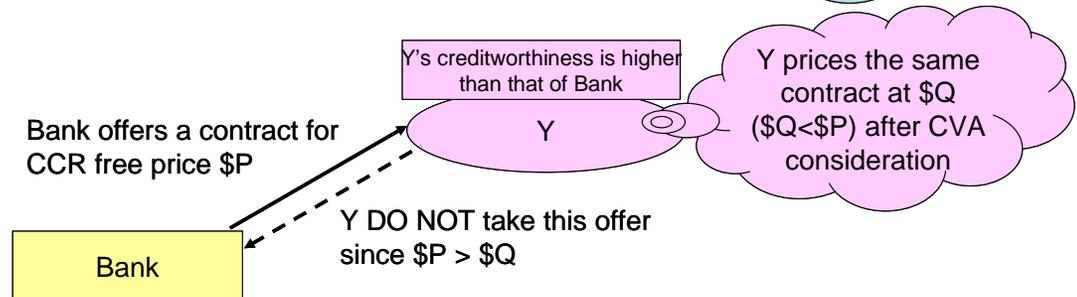
CVA and Adverse Selection

- **When a bank <Bank> which does NOT consider CVA tries to sell a derivative contract to a CP（<X> has lower creditworthiness than Bank and <Y> has higher）which does consider CVA, the result are shown below:**
  - ➢ **Case I: Bank tries to sell to X**
    - ⇒ **The trade is done!**

Bank

Bank offers a contract for CCR free price $P

X takes this offer
since $P < $Q

X
X's creditworhiness is lower
than that of Bank

X prices the same
contract at $Q
($Q>$P) after CVA
consideration

  - ➢ **Case II: Bank tries to sell to Y**
    - ⇒ **The trade is NOT accepted**

Y's creditworthiness is higher
than that of Bank

Y

Y prices the same
contract at $Q
($Q<$P) after CVA
consideration

Bank offers a contract for
CCR free price $P

Y DO NOT take this offer
since $P > $Q

Bank

- **When CP takes CVA into account, a bank which does not consider CVA wins transactions only with less creditworthy CP**
- ⇒ **CCR of Banks may accumulate to a huge amount**

Advantages and Drawbacks in Utilizing CVA

- **Lessons from Failure of Lehman Brothers**
  "Marking to market of CCR and hedging are necessary"
- **Advantages in Utilizing CVA**
  - **Making marking to market of CCR and hedging practicable ⇒ Able to prevent huge losses even under a financial crisis**
  - **Able to prevent adverse selection problems**
- **Drawbacks in Utilizing CVA**
  - **High adoption cost**
- **Other topics to consider**
  - **Whether accounting standard requires MtM of CCR on derivatives or not**
- **When there are growing number of banks utilizing CVA, what would be the reason for not utilizing it？**
  - **Result from weighing potential advantages against drawbacks involved.**
  - **Issue of business practices: it would be difficult to charge CVA to the CP in most transactions**
  - **Issue of accuracy: cannot observe CP's creditworthiness accurately**
  - **Issue of technology: difficult to introduce a mechanism in controlling both derivative pricing and collateral management**
    - **⇒ The above factors may have multiple affects.**
- **Unless CVA is utilized, will there be some possibilities of 1) difficulty in transaction with blue-chip counterparts, or 2) incurring huge losses (as in the case of the failure of Lehman Brothers) when economic conditions suddenly aggravate？**

Discussions and Developments in Regulations

Treatment of CVA Under the Present Capital requirement regulation and Issues Raised After the Current Financial Crisis

- **Treatment of CVA under the present capital requirement regulation**
  - When creditworthiness of counterparty deteriorates, CVA will rise, and mark-to-market price of counterparty exposure will decline equivalently with the amount of CVA's increase. As a result, bank will register losses.
  - At the moment, there is no specific framework to measure capitals which will correspond to risks related to CVA changes.

- **Issues raised after the current financial crisis**
  - As a result of deterioration of creditworthiness of counterparties, their credit spreads widened suddenly, and many banks registered losses due to CVA change.
  - Two-thirds of CCR losses from the current crisis seemed to be due to the CVA losses triggered by changes in exposures and creditworthiness.

Consultative Proposals by the Basel Committee

- **The Committee proposes to strengthen the capital requirements for mark-to market price changes (CVA changes) in OTC derivative exposures.**
  - Since the proposal does not consider "advantages in values of bank's own default", constituents which account for mark-to-market price change of exposures are: 1) change of CP's creditworthiness, and 2) change of prices in underlying assets.

- **Target of CCR measurement is OTC derivative transactions in both trading and banking account.**

- **Since mark-to-market price change risk is assumed as the market risk charge for bond's expected losses issued by counterparty, a capital add-on is introduced.**

- **The Committee is making modifications in the computational equation, based on QIS results.**

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