



# Credit Risk in Banking

CREDIT DERIVATIVES

Hull J., *Options, futures, and other derivatives*, Ed. 7, chapter 23

Sebastiano Vitali, 2017/2018

# Credit derivatives

Credit derivatives are contracts where the payoff depends on the creditworthiness of one or more commercial or sovereign entities

# Credit derivatives

- ▶ Single name – when the reference entity is a single company or country
  - ▶ Credit Default Swaps (CDS)
- ▶ Multiname – when the derivative refers to a set of reference entites.
  - ▶ Collaterized Debt Obligation (CDO)

# CDS

- ▶ Provides insurance against the risk of default by particular company. In particular, the buyer of the insurance obtain the right to sell bonds issued by the company for their face value when a credit event occurs.
- ▶ The company is known as **reference entity**
- ▶ The default is known as **credit event**
- ▶ The total face value of the underlying bond is known as **notional principal**

# CDS - Example

Two parties enter a 5-year CDS. Notional principal 100mln, the buyer pays 90bp annually for protection.

90bp per year: 900.000\$



Purchase of the bond if  
default occurs

Assume default occurs and the market value of the bond is 35mln, the seller will give to the buyer 65mln

# CDS – Pricing

Example in Excel

# CDS – More contracts

- ▶ **Binary CDS**

- ▶ regular CDS with recovery rate set to zero

- ▶ **Forwards on CDS**

- ▶ obligation to buy or sell a particular CDS at a future time  $T$

- ▶ **Options on CDS**

- ▶ right to buy or sell a particular CDS at a future time  $T$
- ▶ If CDS spread strike is 280bp, the CDS call option will be exercised if the CDS spread will be above 280bp

# CDS – More contracts

## ▶ **Basket CDS**

- ▶ *Add-up basket* CDS: payoff when any of the reference entities default
- ▶ *First-to-default* CDS: payoff when the first default occurs.
- ▶ *Second-to-default* CDS: payoff when second default occurs.
- ▶ *kth-to-default* CDS: payoff when  $k$ th default occurs.
  
- ▶ Pricing is similar to regular CDS



# Total return swap

- ▶ Provides insurance against the risk of default by particular company. In particular, the buyer of the insurance (total return payer) gives to the seller (total return receiver) all the cashflows generated by a bond and receives a fixed payment.

# Total return swap – Example

- ▶ Payer: Coupon bond 4% per year, principal 100mln, actual value 90mln maturity 5 years.
- ▶ Receiver: EURIBOR + 40bp
- ▶ Total return swap with maturity 3 years

No default case, bond value at the TRS maturity = 93mln

1 year

Payer:

$$100*(1+0.04)$$

Receiver:

$$100*(1+Eur+0.004)$$

2 year

Payer:

$$100*(1+0.04)$$

Receiver:

$$100*(1+Eur+0.004)$$

3 year – bond value 93mln

Payer:

$$100*(1+0.04)+3$$

Receiver:

$$100*(1+Eur+0.004)$$

# Total return swap – Example

- ▶ Payer: Coupon bond 4% per year, principal 100mln, actual value 90mln maturity 5 years.
- ▶ Receiver: EURIBOR + 40bp
- ▶ Total return swap with maturity 3 years

No default case, bond value at the TRS maturity = 88mln

1 year

Payer:

$$100*(1+0.04)$$

Receiver:

$$100*(1+Eur+0.004)$$

2 year

Payer:

$$100*(1+0.04)$$

Receiver:

$$100*(1+Eur+0.004)$$

3 year – bond value 88mln

Payer:

$$100*(1+0.04)$$

Receiver:

$$100*(1+Eur+0.004)+2$$

# Total return swap – Example

- ▶ Payer: Coupon bond 4% per year, principal 100mIn, actual value 90mIn maturity 5 years.
- ▶ Receiver: EURIBOR + 40bp
- ▶ Total return swap with maturity 3 years

Default case, market value of the bond at default = 30mIn

1 year

Payer:

$$100 * (1 + 0.04)$$

Receiver:

$$100 * (1 + \text{Eur} + 0.004)$$

2 year – default

Payer:

$$100 * (1 + 0.04)$$

Receiver:

$$100 * (1 + \text{Eur} + 0.004) + 70$$

# Asset-backed securities (ABS)

- ▶ It is a security created from a portfolio of asset which generates cashflows.
- ▶ A bank has a basket of subprime loans.
- ▶ The bank decides to sell them to a special purpose vehicle (SPV).
- ▶ The SPV issues bonds (ABS) in tranches guaranteeing the bond's coupon and principal with the cashflows of the loans.
- ▶ Investors buy these ABS and pay the price to the SPV who uses this money to pay the bank

# Asset-backed securities (ABS)

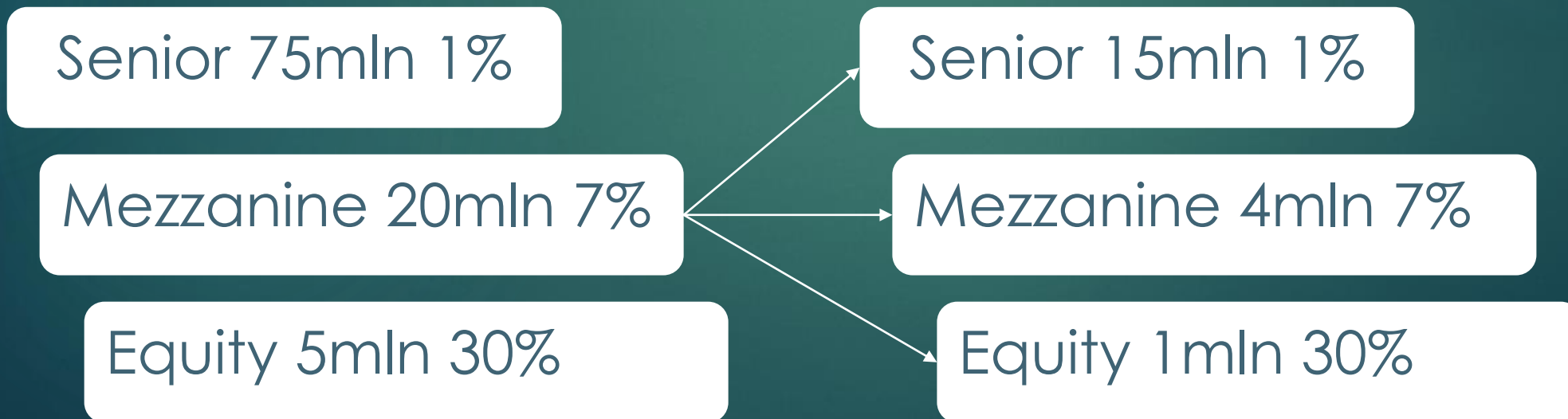
- ▶ The tranches structure reflect the seniority of the ABS, i.e. higher seniority corresponds to first-to-be-paid ABS till all cashflows generated by loans are used.

Loans generate 1 mln of cashflows



# ABS - CDO

- ▶ A tranche is sold to another SPV which issues other tranches which are called ABS-CDO.



# Collateralized debt obligations (CDO)

- ▶ A particular type of ABS is called CDO.
- ▶ Its characteristic is that the assets are bonds issued by companies or countries.
- ▶ Then the structure of the CDO reflects the structure of the ABS
- ▶ The core risk to consider in multiname credit derivatives is correlation



# Multiname credit derivatives

- ▶ Assume to have basket of 100 references, each with default probability 2% in one year. We want to price a 1-year  $k$ th-to-default CDS.
- ▶ If we consider independence between entities then binomial distribution
  - ▶ *first-to-default* CDS: probability of the event is 86.74%
  - ▶ 10<sup>th</sup>-to-default CDS: probability of the event is 0.0034%
- ▶ If we consider perfect dependence between entities then
  - ▶ *first-to-default* CDS: probability of the event is 2%
  - ▶ 10<sup>th</sup>-to-default CDS: probability of the event is 2%

# Synthetic CDO



- ▶ A long position in a bond has essentially the same credit risk as a short position in the corresponding CDS (protection seller).
- ▶ Then, instead of forming a portfolio of corporate bonds, we can build a portfolio of short positions in CDS.
- ▶ Finally, the credit risk originated from the short position on CDS are passed on to tranches.
- ▶ Such tranches are called synthetic CDO