

**FIXED-INCOME SECURITIES**

Lecture 16

*Exotic Options and Credit Derivatives*

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**Outline**

- Interest-Rate Exotic Options
  - Different Types of Options
  - Examples of Exotic Options
  - Pricing Exotic Options
- Credit Derivatives
  - Definition and Typology
  - Credit Default Swaps
  - Credit Linked Notes
  - Credit Spread Option
  - Total Return Swaps

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**Interest-Rate Exotic Options**  
**Different Types of Options**

- Interest-rate exotic options usually are
  - Path-dependent
  - Correlation-dependent
  - Time-dependent
  - Or a mix of these features
- Path-dependent options: option payoffs are a function of the path that interest rates follow over the option life
- Correlation-dependent options: option payoffs are based on the relationship between several interest rates
- Time-dependent options: the buyer has the right to choose an option characteristic as a function of time
- Options can also be exotic because of the way they can be exercised
  - For example, a Bermudan option can be exercised on several specified dates until maturity

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**Interest-Rate Exotic Options**  
**Barrier and Bounded Caps and Floors**

- There are 4 different types of barrier caps and floors
  - Up-and-In barrier cap: this cap is activated when the reference rate reaches or goes above the barrier during a certain period of time (American style) or is equal or above the barrier at expiry (European style)
  - Up-and-Out barrier cap: this cap is de-activated when the reference rate reaches or goes above the barrier during a certain period of time (American style) or is equal or above the barrier at expiry (European style)
  - Down-and-In barrier floor: this floor is activated when the reference rate reaches or falls below the barrier (American style) or is equal or below the barrier at expiry (European style)
  - Down-and-Out barrier floor: this floor is de-activated when the reference rate reaches or falls below the barrier (American style) or is equal or below the barrier at expiry (European style)
- Bounded caps and floors (a.k.a. B-caps and B-floors) are caps and floors whose payout is limited to a particular amount of money (can also be bounded and barrier at the same time)
- These exotic products offer a reduced cost compared with caps, floors, barriers caps and floors, but of course a lower protection

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**Interest-Rate Exotic Options**  
**More Exotic Options**

- Captions and Floortions
  - A caption (floortion) is an option that gives the buyer the right to buy or sell a cap (a floor) at the maturity date and for a specified premium
- Chooser- and Flexicaps-and-floors
  - Choosercaps (floors) and flexicaps (floors) offer the buyer a maximum (minimum) interest rate for a limited number n of caplets (floorlets) and not for all the caplets (floorlets) that constitute the cap (floor)
  - With a flexicap (floor), the guaranteed maximum (minimum) rate applies to the first n number of fixings that are greater than the strike rate (after which no more protection)
  - With a choosercap (floor), the buyer decides to exercise n caplets (floorlets) in the money amongst all the caplets (floorlets) in the money
- Moving Average Caps and Floors
  - A moving average cap (floor) is a cap (floor) whose payoff depends on the maximum of reference rate averages calculated over several periods, called window periods
- Contingent Premium Caps and Floors
  - A contingent premium cap (floor) is a standard cap (floor) where the buyer pays a smaller premium than for a cap (floor), but may have to pay an additional premium if the reference rate goes above (below) a specified contingent level on any one reset date
  - The contingent premium cap (floor) is an adequate protection when the buyer expects rates to stay below (above) the contingent level

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**Interest-Rate Exotic Options**  
**More Exotic Options**

- Extendible Swaps
  - An extendible swap is a plain-vanilla swap where one party has the right at a determined date, or at several future dates, to extend the swap maturity for a specified period
- Cancellable Swaps
  - A callable (putable) swap is a structure where the fixed-rate payer (receiver) of a swap buys a receiver (payer) swaption, so that it has the right to cancel the swap at maturity (European style) or at some specified dates during the swap life (Bermudan style)
- Range Accrual Swap
  - A range accrual swap (a.k.a corridor) is a swap where the interest on the fixed leg accrues only when a floating reference rate is in a certain range
  - The range can be fixed or moves during the product life
  - This product is used by investors who anticipate that rates will remain stable into a range, or, on the contrary, anticipate that rates will be affected by a large volatility

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## Interest-Rate Exotic Options

### More Exotic Options

- **N-Caps (a.k.a. Double Strike Caps) and Floors**
  - A N-cap (N-floor) is a modified version of the up-and-out cap (down-and-out floor)
  - Recall that the up-and-out cap (down-and-out floor) is deactivated when the reference rate reaches or goes above (falls below) the barrier
  - When the barrier is reached in a N-cap (N-floor), the original cap is replaced by another one with a higher (lower) strike
  - A N-cap (N-floor) is the sum of an Up-and-Out cap (Down-and-Out floor) and an Up-and-In cap (Down-and-In floor) with different strike rates but the same barrier.
- **Pros and cons**
  - The price of a N-cap (N-floor) is higher than the price of an Up-and-Out cap (Down-and-Out floor) but lower than that of a cap (floor)
  - The protection provided by a N-cap (N-floor) is between that of an Up-and-Out cap (Down-and-Out floor) and that of a cap (floor)

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## Interest-Rate Exotic Options

### More Exotic Options

- **Ratchet Caps and Floors**
  - A ratchet cap (floor), also known as adjustable strike cap (floor), or sometimes called momentum cap (floor), is a cap (floor) whose strike depends on the last fixing of the reference rate
  - Examples: ratchet cap (floor), ratchet cap (floor) with margin, variomax, momentum cap, momentum floor
  - Ratchetcaps and floors are structured so that they may better incorporate anticipations of the buyer and/or the next future evolution of the yield curve
- **Reflex Caps and Floors**
  - A reflex cap (floor) is a standard cap (floor) with two distinguishing features
    - First, the premium is paid periodically
    - Secondly, each premium is paid if the reference rate goes above (below) a specified barrier
  - Buyers of these products benefit from a protection against the interest-rate risk, while taking some bets on the yield curve level in order to diminish the hedging cost

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## Interest-Rate Exotic Options

### More Exotic Options

- **Rolling Caps and Floors**
  - Rolling caps and floors are modified version of caps and floors
  - As opposed to caps and floors, where the notional amount is the same on each payment date, the notional amount of rolling caps and floors can increase over their life
  - More precisely, each time a caplet or floorlet is not exercised, its nominal amount is added to the nominal amount of the next one
- **Spread Options**
  - A spread option is an option whose payoff depends on the difference between two rates
  - These two rates can be extracted from the same yield curve or not
- **Subsized Swaps**
  - A subsidized swap is the combination of a plain-vanilla swap where the firm pays the fixed rate with the sale of a cap
  - This product is interesting for a firm which wants to lock in the floating rate of its debt.
    - If the floating rate stays below the cap strike, the firm pays the fixed rate minus the prorated cap premium
    - If the floating rate goes above the cap strike, the firm pays the floating rate minus the difference between the cap strike plus the prorated premium minus the swap fixed rate

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## Interest-Rate Exotic Options

### Pricing of Exotic Options

- Since most exotic products have complex random payoffs, very few prices may be obtained closed-form
- To obtain a price for these instruments, one first has to precisely derive the payoff structure, and then use numerical methods such as
  - Binomial and trinomial trees, consisting in a discretization of the stochastic process followed by the factors
  - Monte-Carlo methods, which consist of generating a very large number of paths for the variables of interest under the risk-neutral measure, and then take an average of the payoffs over these paths
  - Finite difference methods, consisting in a discretization of the partial differential equation associated to the price of the contingent claim of interest

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## Credit Derivatives

### Definition and Typology

- Credit derivatives can be defined as arrangements that allow one party (protection buyer or originator) to transfer credit risk of a reference asset, which it may or may not own, to one or more other parties (the protection sellers)
- Credit derivatives can be divided into three main categories
  - Credit derivatives designed as hedging vehicles for default risk (e.g., credit default swaps (CDS) and credit linked notes (CLNs))
  - Credit spread derivatives, based on differences in creditworthiness (e.g., credit spread options (CSOs) and spread forwards)
  - Products that synthetically replicate the performance of the underlying (e.g., total return swaps (TRSs) and total return linked notes)

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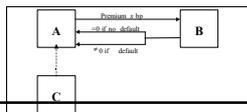
## Credit Derivatives

### Credit Default Swap

- In a CDS, the protection seller agrees, for an upfront or continuing premium or fee, to compensate the protection buyer upon the happening of a specified event, such as a default, downgrading of the obligor, etc.
- Credit default swap covers only the credit risk inherent in the asset, while risks on account of other factors such as interest rate movements remains with the originator

**EXHIBIT A – CREDIT DEFAULT SWAP**

Bank A is a protection buyer. It pays spread  $s$ , known as a premium, at regular intervals. Bank B is a protection seller: if a credit event occurs on reference issuer C, Bank B pays pre-arranged cashflows to Bank A.




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## Credit Derivatives

### Credit Spread Options

- Credit-spread products enable hedgers to acquire protection from unfavorable movements of an asset as measured by a widening of the asset's credit spread
- A credit spread option transfers the credit spread risk from the credit spread hedger to the investor in return for a premium
- One particular type of credit option is a put option where of the option has the right to sell the spread to the seller of the option
  - If the spread increases above the particular strike spread then the buyer of the option benefits from the sale of the spread
  - Under a call option the buyer of the option has the right to buy the spread if it decreases below a certain spread and thus benefiting from the fall in spread
- Credit spreads products can have many variations
  - European or American
  - Can include knock-in or knock-out features, etc.

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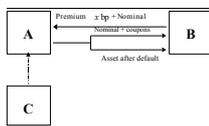
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## Credit Derivatives

### Credit-Linked Notes

- The investor who buys the notes has to suffer either a delay in repayment or has to forego interest, if a specified credit event, say, default or bankruptcy, takes place
- This device also transfers merely the credit risk and not other risks involved with the credit asset
- In short, a CLN is a synthetic defaultable bond

**EXHIBIT B – CREDIT LINKED NOTE**  
*Entity A issues a CLN on reference issuer C. Investor B buys the CLN as if it were buying a risky bond with embedded options on the default risk of Company C.*




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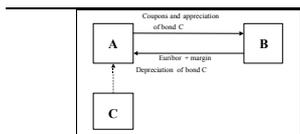
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## Credit Derivatives

### Total Return Swap

- A TRS is a swap of the total return out of a credit asset against a contracted prefixed return
  - The protection seller here guarantees a prefixed return to the originator
  - The protection buyer swaps the total return from a credit asset for a predetermined, prefixed return.

**EXHIBIT C – TOTAL RETURN SWAPS**  
*Entity A buys protection from Entity B, transferring to it all the cashflows on bond C, together with any value-changes. In return, B pays A a reference rate (Euribor) plus a margin, together with any net depreciation in value of bond C.*




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