**Interest Rate Derivatives**

**(IRD)**

Table of content…

# [IRD: An Introduction](#CDSAnIntroduction)

# [Interest Rate Derivatives: An Introduction](#InterestRateDerivativesAnIntroduction)

# [Products Supported by IRD](#IRDProductsSupportedbyCDS)

# [Different OTC Products in IRD](#DifferentOTCProductsinCDS)

# [Swaps in IRD and their brief description](#SwapsinCDSandtheirbriefdescription)

# [IRD Swap Pricing Module](#CDSSwapPricingModule)

# [Common Information](#CommonInformation)

# [OTC Information](#OTCInformation)

# [Terms and Conditions Information](#TermsandConditionsInformation)

# [Swaption](#Swaption)

# [Components of Swaption](#ComponentsofSwaption)

# [Options](#Options)

# [Call Options](#CallOptions)

# [Put Options](#PutOptions)

# [Options Style](#OptionsStyle)

# [Types of Swaption Contracts](#TypesofSwaptionContracts)

# [Payer Swaption](#PayerSwaption)

# [Receiver Swaption](#ReceiverSwaption)

# [Swaptions Market](#SwaptionsMarket)

# [Swaption Pricing Screen](#SwaptionPricingScreen)

# [How IRD deals with Swaptions](#HowCDSdealswithSwaptions)

# [Premium Window](#PremiumWindow)

# [Exercise Window](#ExerciseWindow)

# [Cancelable Swap](#CancelableSwap)

# [Cap/Floors/Straddles](#CapFloorsStraddles)

# [Cap](#Cap)

# [Benefits of Cap](#BenefitsofCap)

# [Features of Cap](#FeaturesofCap)

# [Floor](#Floor)

# [Benefits of Floor](#BenefitsofFloor)

# [Features of Floor](#FeaturesofFloor)

# [Use of Caps and Floors](#UseofCapsandFloors)

# [Types of Caps and Floors](#TypesofCapsandFloors)

# [Cap/Floor Pricing in IRD](#CapFloorPricinginCDS)

# [Straddles](#Straddles)

# [FRAs](#FRAs)

# [Definition](#FRADefinition)

# [FRA Mechanics](#FRAMechanics)

# [FRA Pricing](#FRAPricing)

# [Some Examples on FRAs](#SomeExamplesonFRAs)

# [Exchange Traded Products Supported in IRD](#ExchangeTradedProductsSupportedinCDS)

# [Money Market Futures](#MoneyMarketFutures)

# [Money Market Future Options](#MoneyMarketFutureOptions)

# [Bond Futures](#BondFutures)

# [Bond Future Options](#BondFutureOptions)

# [Bond Options](#BondOptions)

# [Conclusion](#Conclusion)

# [Miscellaneous](#Miscellaneous)

* 1. [Appendix A - References](#AppendixAReferences)
  2. [Appendix B - Glossary of Terms](#AppendixBGlossaryofTerms)

# IRD: An Introduction

# Interest Rate Derivatives: An Introduction

An **interest rate derivative** is a derivative where the underlying asset is the right to pay or receive a notional amount of money at a given interest rate. In financial terms, a *derivative* is a financial instrument - or more simply, an agreement between two people or two parties - that has a value determined by the price of something else (called the underlying). It is a financial contract with a value linked to the expected future price movements of the asset it is linked to - such as a share or a currency. There are many kinds of derivatives, with the most notable being swaps, futures, and options. However, since a derivative can be placed on any sort of security, the scope of all derivatives possible is near endless. Thus, the real definition of a derivative is an agreement between two parties that is contingent on a future outcome of the underlying.

# Products Supported by IRD

* Over the counter (OTC)
  + Swaps
  + Swap option
  + Caps/Floors/Straddles
  + Forward Rate Agreements (FRAs)
  + FX Spots/Forwards
* Exchange Traded Products (ET)
  + Money Market Futures
  + Money Market Future Options
  + Bond Future
  + Bond Futures options

# Different OTC Products in IRD

# Swaps in IRD and their brief description

A swap is a cash-settled OTC derivative. Except for forwards, swaps are the simplest form of OTC derivative.

A swap is an agreement between two counterparties to exchange two streams of cash flows—the parties "swap" the cash flow streams. Those cash flow streams can be defined in almost any manner. All that matters is that their present values be equal (except for a bid-ask spread, if one party to the swap is a dealer). While swaps are used for various purposes—from hedging to speculation—their fundamental purpose is to change the character of an asset or liability without liquidating that asset or liability.

For example, an investor realizing returns from an equity investment can swap those returns into less risky fixed income cash flows—without having to liquidate the equities. A corporation with floating rate debt can swap that debt into a fixed rate obligation—without having to retire and reissue debt.

Following are the swaps supported by IRD

* Vanilla Swap
* Cross Currency Swap
* Asset Swap
* Fx Reset Swap
* Amortizing Swap
* Compounding Swap
* Overnight Index Swap
* Constant Maturity Rate Swap(CMS)
* Quanto swap
* Basis Swap

A **Vanilla Swap** is any swap with fairly standardized provisions. The term is usually applied to vanilla interest rate swaps or vanilla currency swaps. Vanilla swaps are appealing because pricing tends to be transparent and transaction costs are small. Vanilla swaps can be used to speculate or to quickly hedge the market risk of a position without necessarily offsetting the specific cash flows of that position.

Vanilla swaps have two legs – pay leg and receive leg. In which one leg is based on fixed rate of interest while other one is based on floating rate of interest.

Swaps can also be customized to offset the specific cash flows of a position. Dealers often structure such non-vanilla swaps for clients. They may charge a fee for doing so, and pricing may reflect a large bid-ask spread (caveat emptor).

A **Cross Currency Swap (CC Swap)** is an instrument that may be used to swap the interest-rate and currency risk on a loan. A CC Swap is often used in conjunction with the issue of a debenture loan. Using a CC Swap may reduce the funding charges.

Cross Currency Swaps are suitable for companies that wish to control the interest-rate risks in foreign currencies stemming from their standard business operations.

* A CC Swap enables a company to obtain funding in a specific currency and swap it to another currency in order to reduce costs.
* A CC Swap is a bespoke product and can, in terms of the calculation principal, starting date and underlying term, be very closely tailored to the user's requirements.
* Installment and drawdown schedules are possible.
* With a CC Swap, it is easy to swap the currency of the cash flow and the nature of the corresponding interest flows temporarily.
* A CC Swap can be easily wound up. This occurs by means of settlement of the spot value of the swap. This may be negative (penalty interest) or positive (income).

An **Asset swap** is a non-vanilla swap customized to change the character of a specific asset. It is an exchange of tangible assets for intangible assets or vice versa. Since it is a swap of assets, the procedure takes place on the active side of the balance sheet and has no impact on the latter in regards to volume. As an example, a company may sell equity and receive the value in cash thus increasing liquidity.

A company often utilizes this method when in need for money to invest (internal financing) or to pay-off debts. Such swaps usually have stub periods in order to bring the chronology of the cash flows into line with that of the underlying bond.

In finance, a **forex swap** (or **FX Reset swap**) is a simultaneous purchase and sale of identical amounts of one currency for another with two different value dates (normally spot to forward).

An FX rate swap consists of two legs:

* A spot foreign exchange transaction, and
* A forward foreign exchange transaction.

These two legs are executed simultaneously for the same quantity, and therefore offset each other.

It is also common to trade forward-forward, where both transactions are for (different) forward dates.**Amortizing swap** is usually an interest rate swap in which the notional principal for the interest payments declines during the life of the swap, perhaps at a rate tied to the prepayment of a mortgage or to an interest rate benchmark such as the London Interbank offer rate (Libor).

In the case of a **Compounding swap,** the interest is capitalized and paid out during and/or at the end of the term. Whether or not the nominal amounts are swapped in the process is of no significance. As is the case with all swaps, the interest rate flows for a compound swap are generated according to the interest rate conditions.

An **Overnight Indexed Swap** (OIS) is a fixed/floating interest rate swap with the floating leg tied to a published index of a daily overnight rate reference. The term ranges from one week to two years (sometimes more). The two parties agree to exchange at maturity, on the agreed notional amount, the difference between interests accrued at the agreed fixed rate and interest accrued through geometric averaging of the floating index rate.

This means that the floating rate calculation replicates the accrual on an amount rolled “P plus I” at the index rate every business day over the term of the swap. If cash can be borrowed by the swap receiver on the same maturity as the swap and at the same rate and lent back every day in the market at the index rate, the cash payoff at maturity will exactly match the swap payout: the OIS acts as a perfect hedge for a cash instrument. Since indices are generally constructed on the basis of the average of actual transactions, the index is generally achievable by borrowers and lenders. Economically, receiving the fixed rate in an OIS is like lending cash. Paying the fixed rate in an OIS is like borrowing cash. Settlement occurs net on the earliest practical date. There is no exchange of principal.

A **Constant maturity swap**, also known as a **CMS**, is a swap that allows the purchaser to fix the duration of received flows on a swap.

The floating leg of an interest rate swap typically resets against a published index. The floating leg of a constant maturity swap fixes against a point on the swap curve on a periodic basis.A constant maturity swap is an interest rate swap where the interest rate on one leg is reset periodically, but with reference to a market swap rate rather than LIBOR. The other leg of the swap is generally LIBOR, but may be a fixed rate or potentially another constant maturity rate. Constant maturity swaps can either be single currency or cross currency swaps. Therefore, the prime factor for a constant maturity swap is the shape of the forward implied yield curves. A single currency constant maturity swap versus LIBOR is similar to a series of differential interest rate fix (or "DIRF") in the same way that an interest rate swap is similar to a series of forward rate agreements. Valuation of constant maturity swaps depends on volatilities and correlations of different forward rates and therefore requires an interest rate model or some approximated methodology like a convexity adjustment.**A Quanto swap**is an interest rate swap with the floating leg fixed to a foreign floating index. For example, a USD swap Quanto EUR is a Quanto swap agreement. The notional of this contract is in EUR. The fixed payer pays periodically a fixed amount in EUR to his counterparty. In return, the fixed payer receives floating payments in EUR reset at the USD LIBOR rate. Hence, the fixed leg of a Quanto swap is nothing different from the fixed leg of a vanilla interest rate swap; the floating leg of a Quanto swap is different in the sense that its floating payoff is determined by a foreign index.Quanto swap allows investors to separate interest rate risk and foreign exchange risk. **A Basis swap** or a floating/floating cross currency basis swap is a swap in which two streams of money market floating rates of two different currencies are exchanged. In contrast to a standard interest rate swap fixed for floating, notional are exchanged at the starting of the swap and exchanged back at termination. Typical example of a basis swap is swapping dollar Libor versus Yen Libor.

By extension, basis swap refers to floating/floating(cross currency or not) swap in which two streams of floating rates are exchanged, regardless if these floating rates are in the same currency. Typical example of basis swap in the same currency are swapping dollar Libor for floating comm

ercial paper, Prime Treasure bills or Constant Maturity Treasury rates or even 90 days Dollar Libor for 180 days Dollar Libor. In the case of a swap in the same Currencies, notional do not change hands as there is no currency exposure.

# IRD Swap Pricing Module

IRD Swap pricing is divided into following sections…

# Common Information *<*[*follow details*](#CommonInformation)*>*

# OTC Information *<*[*follow details*](#OTCInformation)*>*

# It describes non-economic details of the trade, which do not affect the PV (present value) of the deal.

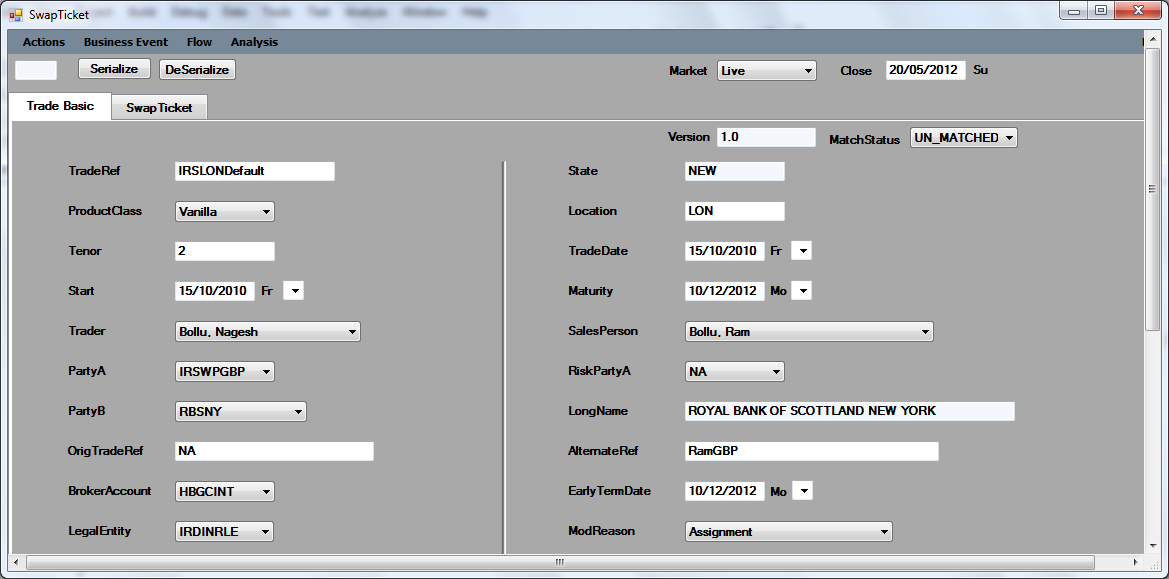
# Example: counterparty name, Trader Name etc...

# Terms and Conditions *<*[*follow details*](#TermsandConditionsInformation)*>*

# It disrobes the economic details of the trade which directly affects the PV.

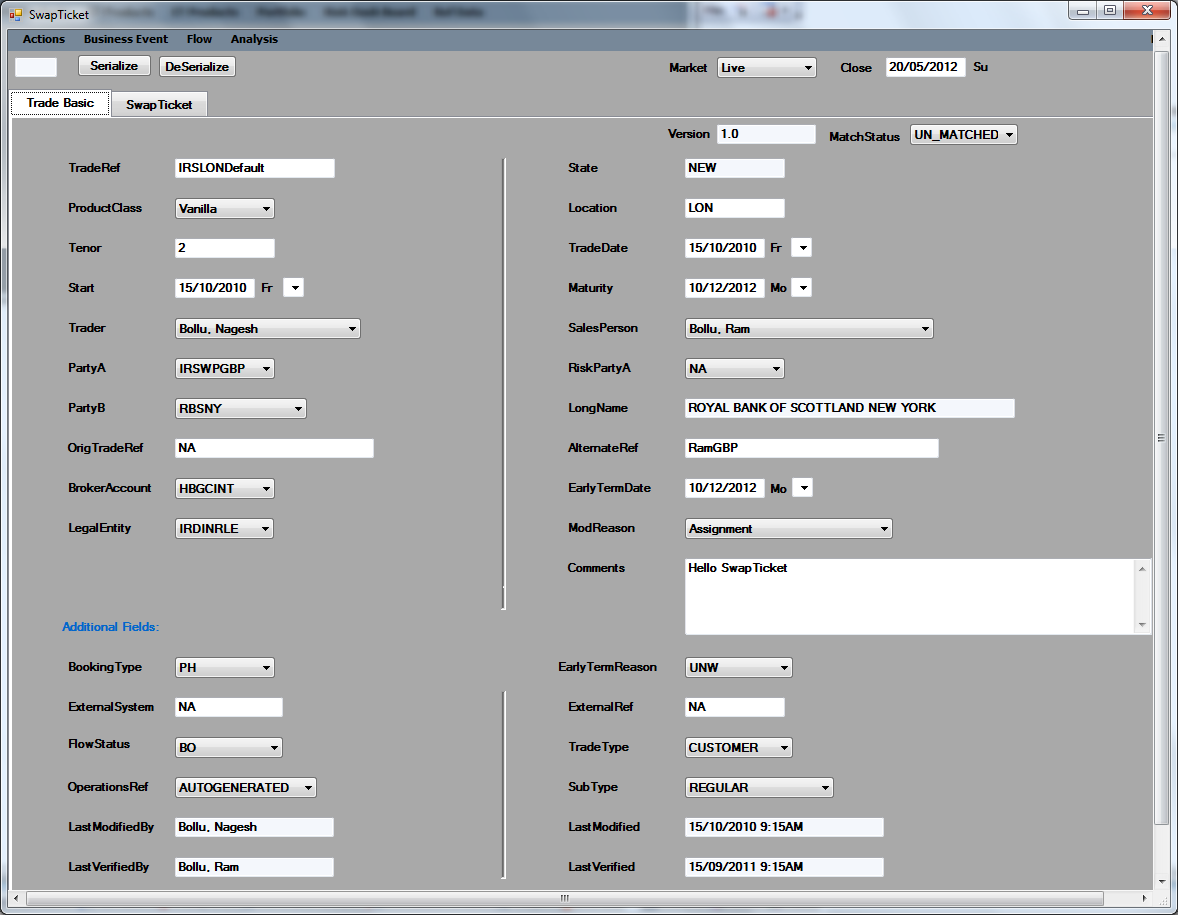
# Example: Notional, Stubs etc...

# Common Information



* **STATUS:** Read only field displaying status of the deal.
* **Env (Environment):** Displays the name of the environment used for pricing this deal.
* **Deal:** Displays the ID of the current deal, if the deal has already been saved. If the deal has not been saved, the Deal field is blank. The Deal field can also be used to call up existing deals in the following ways- If you know the ID of the deal you want, type it into the Deal field and press [Enter].The deal is loaded into the Pricing or deal entry window.
* **Alias (Deal Alias):** Displays an alternate name or ID for this deal. For deals that were converted from the legacy systems, this field displays the "old" ID of this deal for PV reconciliation purposes. For new deals created after IRD went "live", this field can contain any name preferred by the creator of the deal.
* **Value Date:** Specifies the date used for revaluing the deal. For example, you can specify a date in the future or the past, and IRD revalue the deal using the information in the current environment (zcdf and forward rates) as though the entered date were today's date.

# OTC Information



**Operation Information in OTC panel:**

The IRD OTC fields are used to capture *the Non – Economic details* of a deal. The IRD OTC Panel is generic in the sense that the same panel is displayed for capturing the economic details of all IRD traded instruments – Swaps, FRAs, Swaptions etc.

Following are the different fields in OTC…

* **Trader:** The trader field corresponds to the SOE Id of the trader. Upon opening the pricing screen, the user’s SOE Id defaults in the Trader field.
  + - * IRD Screen Field Name -> Trader
      * Oasys Object -> Transaction
      * Oasys attribute -> Trader
* **Trade Date:** The trade date is the date on which the deal was booked in IRD. If the deal is a new deal, then the date will be today’s date.
  + - * IRD Screen Field Name -> Trade Date
      * Oasys Object -> Transaction
      * Oasys attribute -> Trade Date.
* **Transaction No:** Its purpose is to show that transaction numbers associated with OASYS Deals.
  + - * IRD Screen Field Name –> Transactions. No.
      * Oasys Object –> Transaction
      * Oasys attribute -> Transaction ID
* **Originator:** An Originator is a salesperson within the company. An originator generates business within the company and is allowed to enter trades. They cannot authorize these trades however – this can only be done by a trader. The Originator field allows the originator to populate the originator field with their own name.
  + - * IRD Screen Field Name -> Originator
      * Oasys Object -> Transaction
      * Oasys attribute -> Sales Person
* **Book:** Each trader works with a particular book or group of books. Every book has a legal entity associated with it. The book is used to allow a trade to occur between a trading desk and the customer.

The book field is used to specify the book that will bear the credit risk for the deal. The book is the risk bearing entity only when the transaction type is No Multiple.

The book has a Legal Vehicle and Division associated with it that is populated when the book is selected.

* + - * IRD Screen Field Name -> Book
      * Oasys Object –> Transaction
      * Oasys attribute -> Payment Mnemonics
* **Orig. Centre:** The origination centre field must be populated in order for the deal to be saved .It mentions the location where the deal was booked.
  + - * IRD Screen Field Name -> Orig. Centre
      * Oasys Object –> Transaction
      * Oasys attribute –> Origin Centre ID
* **Comp Deal:** This field is simply used to reference the IRD Deal Id of other deals to which the current deal is related. For tracking purposes, it is a very useful field.
  + - * IRD Screen Field Name -> Comp Deal
      * Oasys Object –> Transaction
      * Oasys attribute –> Payment Mnemonics.
* **Struct Ref:** Like the Comp Deal field, the structured reference field is used to provide a reference to which the current deal is related. An important distinction between Comp Deal and Struct Ref is that ***the Struct Ref field is used to relate a IRD Deal Id to a complex exotic structure.***
* An exotic structure will use different types of instruments, all entered into different cross business systems. The IRD role in the exotic structure would generally be to book hedging instruments. To relate all these deals into a single exotic structure, there is an identifier known as a ***Pack number.*** It is this linking identifier that is entered into the IRD Struct Deal field.
* **Counterparty:** The counter party is the customer with whom the deal is being done and is often generically referred to as ‘the Street’.

Each Counterparty has the following attributes…

|  |  |
| --- | --- |
| ***Counterparty Id*** | Unique identifier for the counterparty |
| ***Legal Name*** | Full Name of the counterparty |
| ***GFCID***  ***(Global Financial Customer ID)*** | The number used to identify this counterparty across the entire bank |
| ***Base number*** | The account number of the counterparty in the location in which the deal is being entered |

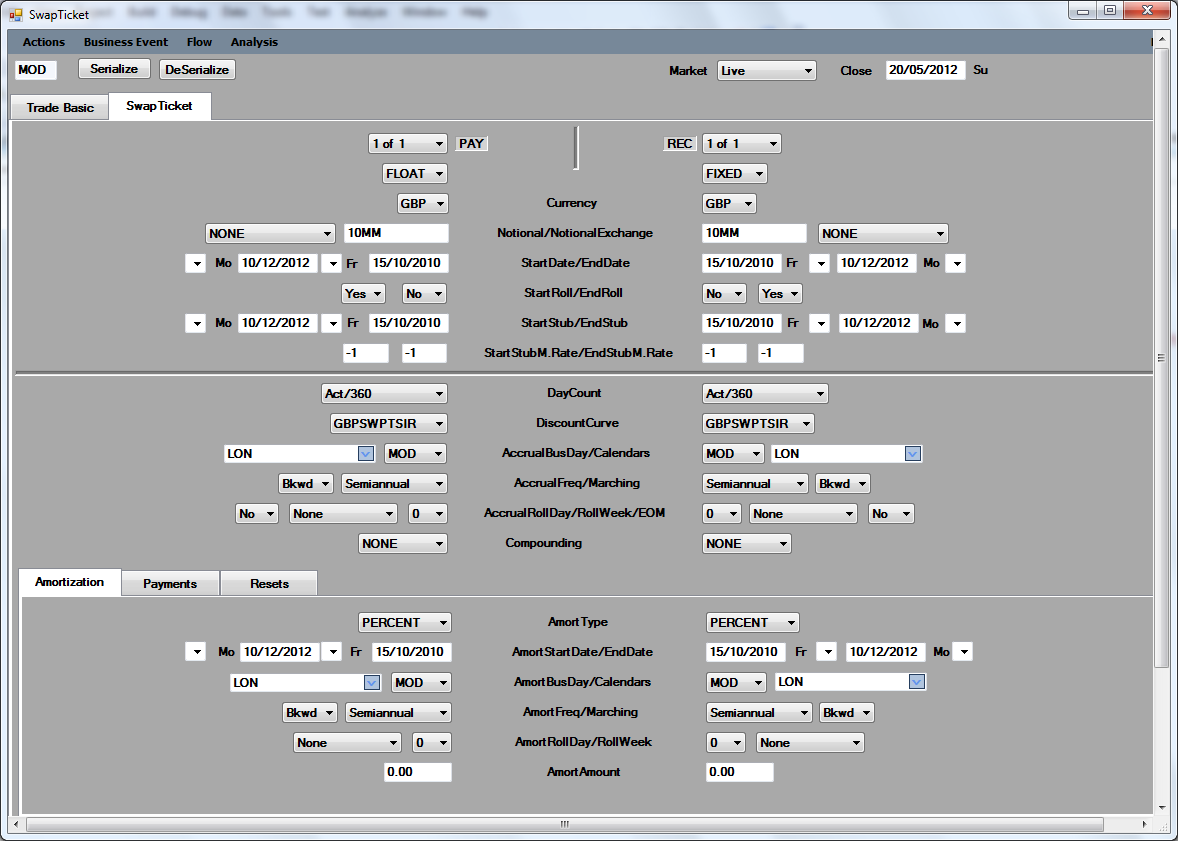
* + - * IRD Screen Field Name -> Counter Party
      * Oasys Object –> Expected Value
      * Oasys attribute –> Counter Party Mnemonics
* **Branch:** If the specified customer id is a multiple branch customer, then the branch location of the counterparty must be chosen from the branch drop down list before the deal can be saved.
* IRD Screen Field Name -> Counter Party
* Oasys Object –> Transaction
* Oasys attribute –> Counter Party Branch
* **Broker Account:** Each deal must have a broker specified. The Broker is an external middle man through which the two counter parties in a deal communicate. Since the broker is the intermediary through whom the deal is done, for the provision of this service, they earn a fee.
* IRD Screen Field Name -> Broker Acct
* Oasys Object –> Fee
* Oasys attribute –> Third Party Mnemonics
* **Comment:** The comment field is a free format field and can be used to enter any detail which the originator and/or trader deem significant in terms of the deal.
* IRD Screen Field Name -> Comment
* Oasys Object –> Event Note
* Oasys attribute –> Note
* **Earning Allocation:** The Earning Allocation field is used to enter the ***Expected Value*** earned by an Originator. Expected Value is the compensation to be paid to the Originator on account of generating the position for the company. Expected Value does not directly affect the PV of a position.
* **Margin: The** book bears the credit risk for the counterparty defaulting. The margin is the amount of money to be paid by the customer to compensate the bank for bearing that credit risk. The amount of the margin is dependent on the credit rating of the customer – the lower the rating, the higher the margin.
* **Status:** Deal entry must be authorized before any deals are saved to the official IRD database – IRD authorized. The status field provides details regarding original deal entry and its subsequent authorization.
* IRD Screen Field Name -> Status
* Oasys Object –> Transaction
* Oasys attribute –> Trade Status
* **Assignment:** The purpose of this field is to allow the counterparty for the particular deal to be changed. However, the counterparty name can be changed directly in the IRD OTC panel and IRD will deal with this change appropriately.
* **Inception PV:** The inception field shows what the PV for the deal was on the day that the deal was originally booked. It does not change at any stage after the deal was originally booked.
* **Credit Information:** Generally this field is not used. It would be used to send credit information to downstream systems.
* **Operation Information:** This field is used to send information downstream which relates to confirmations and settlements. However, this field is not used any more, as OASYS deals with settlements and confirmations.
* **Unwind:** Unwinding a deal in the purest sense means bring the deal to an end. The unwind field details whether or not unwinds will occur, and in case they do, when they will occur and who will initiate them.
* IRD Screen Field Name -> Unwind Date
* Oasys Object –> Transaction
* Oasys attribute –> Early Termination Trade
* **Oasys:** This field is used to provide additional information about any changes made to a deal.

The options available include

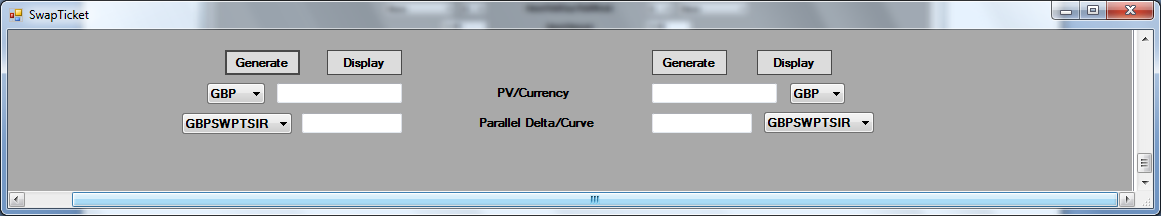
|  |  |
| --- | --- |
| ***Contract Revision*** | Details which affect the confirmation were changed |
| ***Change Strike*** | The rate for the fixed leg was changed |
| ***Partial Bought Back*** | The notional of the deal was reduced |

* **Swapswire:** This field is used to display details if the deal has originated in the eternal vendor system, Swapswire.
* IRD Screen Field Name -> Swapswire
* Oasys Object –> Electronic Processing
* Oasys attribute –> Swaps Wire Version Number

# Terms and Conditions Information



**PV And Net Value Screen in Terms and Conditions Panel:**



* **Tenor:** Lets you specify the tenor of the swap as either a tenor code or as a year fraction, to determine the date for the Termination field. Once you enter a tenor period in the Tenor field, the system generates the termination date based on the tenor entered, taking into account the holiday schedules, frequency, marching and business day conventions (where applicable) specified in the Settlement section. If any of these settlement fields are changed after the tenor is entered, or you change the dates in the Effective and Termination fields, the tenor is calculated and displayed in the Tenor field in year fraction.
* **Eff. (Effective):** Displays the date on which the deal begins. To change the date in this field you can either enter a new date, or use the plus (+) or minus (-) signs to add or subtract days (d), weeks (w), months (m) or years (y) to/from the date displayed. For example, to add five days to the displayed date, highlight the current date by double-clicking on it, type +5d and press [Enter]. The new date is displayed. You can also type t for today.
  + - * IRD Screen Field Name –> Eff
      * Oasys Object –> Transaction
      * Oasys attribute –> Settlement Date
* **Term (Termination):** Displays the termination date of the swap.
  + - * IRD Screen Field Name–Term
      * Oasys Object–Cash Flow Corpus
      * Oasys attribute – Termination Date
* **Notional (Notional Amount):** Specifies the notional amount for this deal. If the notional of the deal is less than 1 million, the entire number is displayed (for example, 230 000). If the notional is greater than 1 million, the number is truncated so that MM represents million (for example-15 500 000 is displayed as 15.5MM)
  + - * IRD Screen Field Name –> Notional
      * Oasys Object –> Credit Support
      * Oasys attribute -> Notional amount
* **Start Stub (Start Date):** The date on which generation of the settlement schedule begins. This date cannot precede the date in the Effective field. To change the date in this field you can either enter a new date, or use the plus (+) or minus (-) signs to add or subtract days (d), weeks (w), months (m) or years (y) to/from the date displayed. For example, to add five days to the displayed date, highlight the current date by double-clicking on it, type +5d and press [Enter]. The new date is displayed. You can also type t for today.
  + - * IRD Screen Field Name -> Start Stub
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> First Period End Date Tenor
* **Front Stub:** Defines the end date of the first period of the deal if there is a front stub. This field defaults to the date in the settlement Start Date field. If the dates in these two fields are different, the stub period goes from the date in the settlement Start Date field to the date in this field.
  + - * IRD Screen Field Name -> Front stub
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> First Period End Date
* **End Stub (End Date):** The last date on which rate reset, amortization, settlement or compounding can occur. This date cannot be later than the date entered in the Termination field. To change the date in this field you can either enter a new date, or use the plus (+) or minus (-) signs to add or subtract days (d), weeks (w), months (m) or years (y) to/from the date displayed. For example, to add five days to the displayed date, highlight the current date by double-clicking on it, type +5d and press [Enter]. The new date is displayed. You can also type t for today.
  + - * IRD Screen Field Name -> End Stub
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Last Period Start Date.
* **Back Stub:** Defines the start date of the last period of the deal if there is a back stub. This field defaults to the value in the settlement End Date field. If the dates in these two fields are different, the stub period goes from the date in this field to the date in the settlement End Date field
  + - * IRD Screen Field Name -> Back stub
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Last Period Start Date
* **Day Count (Day Cnt):**

The method used to determine the number of days between two dates. The day count conventions (of the form day count/year basis) are as follows:

* + - **Actual/Actual ISDA**

The difference between two dates is the actual number of days. The number of days in each year is the actual number of days.

* + - **Actual/Actual ISMA 251**

Under ISMA Rule 251, the denominator is the actual number of days in the coupon period multiplied by the number of coupon periods in the year (subject to exceptions in relation to irregular coupon periods).

* + - **Actual/Actual AFB**

Under the AFB method, the denominator is either 365 (if the calculation period does not contain February 29) or 366 (if the calculation period includes February 29). Where a period longer than one year is involved, two or more calculations are made. Interest is calculated for each full year counting backwards from the end of the calculation period and the remaining initial stub period is treated in accordance with the usual rule. When counting backward for this purpose, if the last day of the relevant period is February 28th, the full year should be counted back to the previous February 28th, unless February 29th exists, in which case, February 29th should be used.

* + - **Actual/365 (Fixed)**

The difference between two dates is the actual number of days. All years have 365 days.

* + - **Actual/360**

The difference between two dates is the actual number of days. All years have 360 days.

* + - **Equal (360/360 (30/360 Unadjusted))**

To use the equal convention, if the period is regular, only a frequency parameter is required. The year is divided into 1/frequency units per year. Each unit contains 360/frequency number of days, with no further subdivision of a unit being possible. This convention is used, for example, in a bond price/yield relationship after the first odd period, if one exists. In a semi-annual paying bond, the frequency is 2, thus providing for units of half-years. That is, each unit contains exactly 360/2 (or 180) days. If there is a stub period, then the Equal day count convention follows from 30B/360.

* + - **30/360 (All Variations)**

Specifies that all months have 30 days and that all years have 360 days. There are four conventions that are varieties of 30/360, described below. (30/360 is not an option in the Day Count Convention field menu.) Once adjustments for months that have other than 30 days are made, the following formula is used in all conventions to calculate the number of days between two dates:

First date & Last date

For the variations of the 30/360 conventions, click variations.

* + - **Act/365.25**

The difference between two dates is the actual number of days. All years have 365.25 days.

* + - **FULL (Full Coupon)**

Specifies that the coupon for the period is not adjusted for day count. That is,

Coupon = notional \* float rate / settle freq

* + - * IRD Screen Field Name -> Day Cnt
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Daycnt.
* **SHOL (Holidays):** The ‘Shol’ tab determines the holiday convention, which will be used when determining the dates on which settlement and payment will occur. Settlement or payment dates that fall on holidays will be modified by IRD to ensure that the payment and/or schedule dates no longer fall on these holidays by adjusting the date and normally moving it to the next good working day.

The currency specified determines the holiday calendar that will be used to determine if the date is a holiday.

For Euro deals, the Euro Zone calendar is known as ‘Target’.

* + - * IRD Screen Field Name -> SHOL
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Periodic Calendars
* **S.Freq (Settlement Frequency):** The ‘S freq’ field refers to the Settlement Frequency for the position - how often payments are sent to and received from the other party. Settlement frequencies such as bimonthly, annual and triannual can be selected from the option menu as the settlement frequency for the swap leg.

The text box in the S.Freq field shows the resultant number of times that settlement is made in a year.

* + - * IRD Screen Field Name -> S.Freq
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Payment frequency
* **March (Marching):** Both March and Bus Day relate to the settlement dates for the swap leg. The marching convention determines the way in which dates in the settlement schedule roll. If the marching convention of **Fwd** is chosen, then the settlement dates will roll forward from the first day of the swap. This may lead to the creation of a back stub. A marching convention of **Bkwd** means that the dates will roll from the end date of the swap to the start of the swap. This may lead to the creation of a front stub.
  + - * IRD Screen Field Name -> March
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Marching Convention
* **Bus Day (Business Day):** The business day convention determines the procedure for date if the settlement date falls on a holiday or a weekend. If the Bus Day is **Fol**, then if the date for settlement falls on a weekend, it is moved forward to the next working day. Similarly, if the Business Day Convention is **Pre**, this dictates that the date should be modified so that it is the last preceding business day.
* An interesting Business Convention is ***Mod or Modified following –*** This convention relates to month end prepayment the date is on a weekend, then move to the next business day. However, if moving to the next business day means that you are moving into the new month, then the date should be brought back to the preceding business day.
  + - * IRD Screen Field Name -> Bus Day
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Payment date Roll convention
* **Compound (Compounding):** The compounding field is used to indicate whether interest compounding is to be taken into account when calculating the PV for a deal, and if so, the nature of the compounding to be applied. A simple example of when compounding could be used is if the customer wishes to receive payments with an annual settlement frequency, but wishes to be sensitive to a six month rate. Hence, the customer wishes that -The rate will be fixed every 6 months based on the selected market index i.e. LIBOR\_6M, Payment will be received annually, and this payment will take into account the two interest resets that occurred during the settlement period.
  + - * IRD Screen Field Name -> Compound
      * Oasys Object– Cash Flow Corpus
      * Oasys attribute –Compounding Convention
* **Underlying:** The underlying field is used to provide additional information for the swap leg. It doesn’t directly affect the cash flows for the deal. One of the primary uses of the underlying field is to indicate is when the swap is used to *mimic a bond in the market.* This is known as a *Par Asset Swap*. The Par Asset Swap and Reg (regular) are the only two options commonly used in swap entry. To say that the underlying doesn’t affect the cash flows isn’t entirely true. If a bond that the Par Asset Swap mimics has interest accrued on it, then this is entered in the Terms and Conditions field. The entry of accrued interest will automatically generate a cash flow which will be taken into account when calculating the net PV for the deal.
* **Rate/Cpn (Rate /Coupon):** The rate is hugely important for the swap legs as it determines the rate used to calculate cash flows. For the fixed leg, the rate is fixed at an agreed percentage. However, the floating leg has a variable rate of interest as determined by some agreed market rate.

The most common interest rate measures are:

* + - **LIBOR:** London Interbank Offered Rate for Sterling swaps.
    - **EURIBOR**: European Inter Bank Offered Rate for Euro swaps

These rates fluctuate throughout the day but the rate used in pricing swaps and determining interest rate payments is the official rates as determined by Reuters at 11.00 AM on each business day

The rate used for the floating leg should correspond to the settlement frequency of the swap.

* + - * IRD Screen Field Name -> Rate/Coupon
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Rate Formula
* <,

|  |  |
| --- | --- |
| **S.Freq** | **Rate** |
| *Qtr (Quarterly)* | EURIBOR\_3M |
| *Semi* | EURIBOR\_6M |
| *An* | EURIBOR\_1Y |

* **Sprd (Spread):** The purpose of the spread field was explained when detailing the compound field.
  + - * IRD Screen Field Name -> Sprd
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Spread
* **Gr (Gearing):** Gearing is used to increase the reset rate by a specified factor. This would resultantly increase the payments for a period by the factor. As such, another way of looking at gearing is the increasing of the notional amount by the specified factor. The idea of gearing could be to increase the float rate to be approximately on par with the fixed rate. Also if you increase the notional through gearing, only the initial notional has to be declared.
  + - * IRD Screen Field Name -> Gear Field
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Gear factor
* **CMT:** Choosing the yes option in this field changes the nature of the swap deal entirely. Selecting yes changes the swap into ***a Constant Maturity Treasury Swap***. Such a swap is based on a ***swap rate from the market***, rather than a market index such a LIBOR.
  + - The rate on which the CMT is based can be the swap rate for any period – for example 5 year or the 20-year rate.
    - If the settlement frequency is semi annual, then the rate still resets every 6 months, but the rate is set off a swap rate that is based on 10-year swaps.
    - Essentially, constructing a CMT achieves the same sensitivities as 10-year bond yields.
    - Generally when the swap is of type CMT, there will be two CMT legs in the swap, one based perhaps on 10-year swap rates, the other based on 20 year swap rates. This aims to maximize the advantage from changing market views.
* **R. Freq (Frequency):** This field dictates how often the rate is fixed. By default the rate is fixed at the start of each settlement period. However, just like with Settlement frequency, the reset frequency can be set to tri-annual, annual, bimonthly etc. The text box in this field shows the actual number of times that the rate will be reset in a year.
  + - * IRD Screen Field Name -> R.Freq
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Reset Frequency
* **First/Last (First/Last Rate): The** first and last text fields allow the trader to specify the rates which will be applied in the first settlement and the last settlement period respectively.

Manually setting the first rate to be applied is a common practice -

Because the rates are fixed in the market at 11.00 a.m., the markets may have changed by the time the trade is booked in IRD.

The first field is often used so that rate applied to the first settlement period reflects the rate in the market at the time the trade was booked.

If the rate is manually specified using the first and last text fields, then the Reset type in the Payment schedule screen is manual – M

The rate entered in the first field or the last field does not include any spread on the deal.

If there is a spread on the deal, then IRD will take the specified first rate plus the spread to arrive at the period rate.

Once again, it is important to note that the ***period rate and not the reset rate*** are applied to the notional to arrive at the cash flows for the settlement period.

* + - * IRD Screen Field Name -> Start Stub
      * Oasys Object –> Cash Flow Corpus
      * Oasys attribute –> Initial/Final Net Rate
* **Reset (Reset In):** There are two option menus in the reset field.

The ***first list box*** determines when the rate is reset, in the sense of it being reset at the start of the period or at the end of the settlement period.

In almost all swaps, this ***reset option will be in advance***, with the quote date on the settlement date (GBP/ZAR) or 2 days prior to the start of the settlement period.

A swap where the reset option is in arrears is known as a ***LIBOR in Arrears swap***.

Two other reset options exist – ***max and min.***

* + - For max, the reset rate will be taken as the higher of the current settlement period’s reset rate, or the preceding periods reset rate.
    - Min is the same principal, with the lower of the two reset rates being chosen. Having max or min as the reset type is the same as having an option – these reset types essentially allow you to benefit from changes in the market. As such, they have a fee associated with them.
* **Leg PV:** Displays the present value (PV) of this leg in the currency displayed in the CCY field.
* **Snap PV:** Consists of a field for each the pay and receive sides as well as an update button (centre column). The fields (pay and receive sides) show the PV of the deal before changes are made to the terms and conditions. That is, if AutoCalc is on, and you make a change to the deal, these fields show the value of the leg prior to the change, allowing you to compare current and previous PVs. The Snap PV button controls when the leg Snap PV fields are synchronized to the current PV of the deal. This allows you to restart the PV comparison process. Clicking the Snap PV button also synchronizes the Snap Net PV field to the Net PV field.
* **Even PV01 (Break Even Rate/Spread):** On the fixed side, displays the fixed rate that, if applied to this fixed leg, causes the net present value (PV) of the swap to approach zero. On the floating side, displays the spread that, if applied to each rate reset in the floating leg, causes the net PV of the swap to approach zero. This field is read-only.
* **AccInt/ZAmt (Accrued Interest):** Displays the interest accrued for this leg from the last settlement date to today. This field is read-only.
* **Delta:** Displays the net of the parallel delta. Note: Calculation of parallel delta uses forward rate perturbation, regardless of the method defined in the current environment.
* **Gamma:** Displays the net of the parallel gamma. Note: Calculation of parallel gamma uses forward rate perturbation, regardless of the method defined in the current environment.
* **Accrued Int (Accrued Interest):** Displays the net of the interest accrued from the last settlement date to today.
* **Total PV:** Displays the total present (PV) for the deal, inclusive of any cash flow adjustments, in the currency specified in the CCY field.

# Swaption

A Swaption is an option granting its owner the right but not the obligation to enter into an underlying swap. Although options can be traded on a variety of swaps, the term "Swaption" typically refers to options on interest rate swaps. A Swaption gives its holder to right to enter into a swap. It is exercised if the strike rate of the swap is more favorable than the prevailing market swap rate, it expires worthless otherwise. If exercised, the holder then enters into an interest rate swap as determined in the Swaption contract.

# Components of Swaption

* **Notional:** The notional amount (or notional principal amount or notional value) on a financial instrument is the nominal or face amount that is used to calculate payments made on that instrument. This amount generally does not change hands and is thus referred to as notional.
* **Maturity of the option:** A type of option in which the put or call matures before the final expiration date. The variable maturity option matures earlier if the underlying instrument significantly changes in price before an early maturity date stated in the option contract.
* **Strike rate:** The fixed price at which the owner of an option can purchase (in the case of a call), or sell (in the case of a put), the underlying security or commodity. It's the price at which the stock will be bought or sold when the option is exercised.The strike price is often called the exercise price.

For example, an IBM May 50 Call has a strike/exercise price of $50 a share. When the option is exercised the owner of the option will buy (Call option) 100 shares of IBM stock for $50 a share.

* **Maturity of the swap (tenor):** A constant maturity swap, also known as a ***CMS***, is a swap that allows the purchaser to fix the duration of received flows on a swap. The floating leg of an interest rate swap typically resets against a published index. The floating leg of a constant maturity swap fixes against a point on the swap curve on a periodic basis. A constant maturity swap is an interest rate swap where the interest rate on one leg is reset periodically, but with reference to a market swap rate rather than LIBOR. The other leg of the swap is generally LIBOR, but may be a fixed rate or potentially another constant maturity rate.
* **Frequency of settlement of the swap:** The ‘S.Freq’ field refers to the Settlement Frequency for the position - how often payments are sent to and received from the other party. Settlement frequencies such as bimonthly, annual and triannual can be selected from the option menu as the settlement frequency for the swap leg.
* **Floating rate:** A floating interest rate, also known as a ***variable rate*** or ***adjustable rate***, refers to any type of debt instrument, such as a loan, bond, mortgage, or credit that does not have a fixed rate of interest over the life of the instrument.

Such debt typically uses an index or other base rate for establishing the interest rate for each relevant period. One of the most common rates to use as the basis for applying interest rates is the London Inter-bank Offered Rate, or ***LIBOR*** (the rates at which large banks lend to each other).

* **Expiry Date:** The last date on which the option can be exercised

However, in order to understand the concept of a Swaption and also the purpose of the fields in the IRD Swaption pricing screen, it is necessary to understand the basics of option.

# Options

In finance, an **option** is a contract between a buyer and a seller that gives the buyer of the option the right, but not the obligation, to buy or to sell a specified asset (underlying) on or before the option's expiration time, at an agreed price, the strike price.

In return for granting the option, the seller collects a payment (the *premium*) from the buyer. Granting the option is also referred to as "selling" or "writing" the option.

There are two types of Options:

|  |  |  |
| --- | --- | --- |
| Option Type | **Swaption Characteristics** | **Swaption Type** |
| ***Put Option to sell the asset*** | Buy Receive Fixed | Receiver Swaption   * + Receive Fixed   + Pay Floating |
| ***Call Option to buy the asset*** | Buy Pay Fixed | Payer Swaption   * + Pay Fixed   + Receive Floating |

# Call Options

A call option gives the buyer of the option the right but not the obligation to buy the underlying at the strike price. It is a financial contract between two parties, the buyer and the seller of this type of option. It is the option to buy shares of stock at a specified time in the future. Often it is simply labeled a "call". The buyer of the option has the right, but not the obligation to buy an agreed quantity of a particular commodity or financial instrument (the underlying instrument) from the seller of the option at a certain time (the expiration date) for a certain price (the strike price). The seller (or "writer") is obligated to sell the commodity or financial instrument should the buyer so decide. The buyer pays a fee (called a premium) for this right.

The buyer of a call option wants the price of the underlying instrument to rise in the future; the seller either expects that it will not, or is willing to give up some of the upside (profit) from a price rise in return for the premium (paid immediately) and retaining the opportunity to make a gain up to the strike price (see below for examples).

Call options are most profitable for the buyer when the underlying instrument is moving up, making the price of the underlying instrument closer to the strike price. The call buyer believes it's likely the price of the underlying asset will rise by the exercise date. The risk is limited to the premium. The profit for the buyer can be very large, and is limited by how high underlings’ spot rises. When the price of the underlying instrument surpasses the strike price, the option is said to be "***in the money***".

# Put Options

A put option gives the buyer of the option the right but not the obligation to sell the underlying at the strike price.

A put option (usually just called a "put") is a financial contract between two parties, the writer (seller) and the buyer of the option. The buyer acquires a short position by purchasing the right to sell the underlying instrument to the seller of the option for specified price (the strike price) during a specified period of time. If the option buyer exercises their right, the seller is obligated to buy the underlying instrument from them at the agreed upon strike price, regardless of the current market price. In exchange for having this option, the buyer pays the seller or option writer a fee (the option premium).

By providing a guaranteed buyer and price for an underlying instrument (for a specified span of time), put options offer insurance against excessive loss. Similarly, the seller of put options profits by selling options that are not exercised. Such is the case when the ongoing market value of the underlying instrument makes the option unnecessary; i.e. the market value of the instrument remains above the strike price during the option contract period.

Purchasers of put options may also profit from the ability to sell the underlying instrument at an inflated price (relative to the current market value) and repurchase their position at the much reduced current market price.

The theoretical value of an option is evaluated according to several models. These models, which are developed by quantitative analysts, attempt to predict how the value of an option changes in response to changing conditions. Hence, the risks associated with granting, owning, or trading options may be quantified and managed with a greater degree of precision, perhaps, than with some other investments. ***Exchange-traded options*** form an important class of options which have standardized contract features and trade on public exchanges, facilitating trading among independent parties. ***Over-the-counter options*** are traded between private parties, often well-capitalized institutions that have negotiated separate trading and clearing arrangements with each other.

# Options Style

Naming conventions are used to help identify properties common to many different types of options. These include:

* **European option** - an option that may only be exercised on expiration.
* **American option** - an option that may be exercised on any trading day on or before expiration.
* **Bermudan option** - an option that may be exercised only on specified dates on or before expiration.

# Types of Swaption Contracts

# Payer Swaption

A Payer Swaption is the right but not the obligation to enter into an Interest Rate Swap where the buyer PAYS fixed rate and receives FLOATING. The buyer will therefore benefit if rates RISE. The initial cost of the Swaption is the premium, and this is the most the buyer can lose. Once purchased the Payer Swaption will have a minimum value of zero.

The Payer Swaption behaves like a CAP (see "INTEREST RATE CAP" section). Where CAPS reference the short end of the yield (3 and 6 months), the Payer Swaption references the longer part of the yield curve, 2 yrs to 10 yrs.

For Example: An Investor believes that the 5 year yield in SEK will be higher than implied in one year but is unwilling to enter a Pay Fixed Swap as they wish to limit their potential loss. They can BUY a Payer Swaption. This will give them the right to pay fixed under a 5 year Swap in one year. The strike rate is the rate at which the Swap will take effect. If rates rise above the strike rate, the client will choose to enter into the Swap, paying Fixed at the strike level. This deal could then be closed out at a profit or allowed to run as a Swap. Should 5 year rates be lower than the strike at maturity, the investor will choose not to pay Fixed under the Swaption as they can do so in the market at a more attractive rate.

**Pricing for Payer Swaption:**

Payer Swaptions are priced with reference to the following:

* Higher Volatility of the underlying leads to higher premium.
* Longer tenor of option leads to higher premium
* Lower strike rates are more expensive than higher strikes

**Target market:**

Borrowers with floating rate debt may wish to buy Payer Swaptions which will convert their liability from floating to fixed when rates rise above the strike. This strategy is similar to a CAP, but under a CAP the borrower remains floating but with a guaranteed maximum level, here the liability is converted to a fixed rate. The option can also be used as a speculative instrument for investors who believe fixed rates will rise, but are unwilling to enter into Swaps.

**Advantages:**

* Limited loss potential (premium)

**Disadvantages:**

* Premium payment required upfront

# Receiver Swaption

A Receiver Swaption is the right but not the obligation to enter into an Interest Rate Swap where the buyer RECEIVES fixed rate and pays FLOATING. The buyer will therefore benefit if rates FALL. The initial cost of the Swaption is the premium, and this is the most the buyer can lose. Once purchased the Receiver Swaption will have a minimum value of zero.

The Receiver Swaption behaves like a Floor. Where Floors reference the short end of the yield curve, ( 3 and 6 months), the Receiver Swaption references the longer part of the yield curve, 2 yrs to 10 yrs.

For example: An Investor believes that the 5 year yield in SEK will be lower than implied in one year but is unwilling to enter a Receive Fixed Swap as they wish to limit their potential loss. They can BUY a Receiver Swaption. This will give them the right to receive fixed under a 5 year Swap in one year. The strike rate is the rate at which the Swap will take effect. If rates fall below the strike rate, the client will chose to enter into the Swap, receiving Fixed at the strike level. This deal could then be closed out at a profit or allowed to run as a Swap. Should 5 year rates be higher than the strike at maturity, the investor will choose not to receive Fixed under the Swaption as they can do so in the market at a more attractive rate.

**Pricing for Receiver Swaption:**

Receiver Swaptions are priced with reference to the following:

* Higher Volatility of the underlying leads to higher premium.
* Longer tenor of option leads to higher premium.
* Lower strike rates are less expensive than higher strikes.

**Target Market:**

Investors with floating rate assets may wish to buy Receiver Swaptions which will convert their assets from floating to fixed when rates fall below the strike. This strategy is similar to a Floor, but under a Floor the investor remains floating but with a guaranteed minimum level, here the asset is converted to a fixed rate. The option can also be used as a speculative instrument for investors who believe fixed rates will fall, but are unwilling to enter into Swaps.

**Advantages:**

* Limited loss potential (premium)

**Disadvantages:**

* Premium payment required up front

**The buyer and seller of the Swaption agree on:**

* The premium (price) of the Swaption
* The strike rate (equal to the fixed rate of the underlying swap)
* Length of the option period (which usually ends two business days prior to the start date of the underlying swap),
* The term of the underlying swap,
* Notional amount,
* Amortization, if any
* Frequency of settlement of payments on the underlying swap

# Swaptions Market

The participants in the Swaption market are predominantly large corporations, banks, financial institutions and hedge funds. End users such as corporations and banks typically use Swaptions to manage interest rate risk arising from their core business or from their financing arrangements. For example, a corporation wanting protection from rising interest rates might buy a payer Swaption. A bank which holds a mortgage portfolio might buy a receiver Swaption to protect against lower interest rates which might lead to early prepayment of the mortgages. A hedge fund believing interest rates will not rise by more than a certain amount might sell a payer Swaption aiming to make money by collecting the premium. Swaption markets exist in most of the major currencies in the world, the largest markets being in U.S. Dollars, Euro, Sterling and Japanese Yen.

The Swaption market is over-the-counter (OTC), i.e., not traded on any exchange. Legally, a Swaption is an agreement between the two counterparties to exchange the required payments. The counterparties are exposed to each others' failure to make scheduled payments on the underlying swap, although this exposure is typically mitigated through the use of "collateral agreements" whereby margin is posted to cover the anticipated future exposure.

A Swaption not only hedges the buyer against downside risk, it also lets the buyer take advantage of any upside benefits. Like any other option, if the Swaption is not exercised by maturity it expires worthless.

If the strike rate of the Swaption is more favorable than the prevailing market swap rate then the Swaption will be exercised as detailed in the Swaption agreement.

* It is designed to give the holder the benefit of the agreed-upon strike rate if the market rates are higher, with the flexibility to enter into the current market swap rate if they are lower.
* The converse is true if the holder of the Swaption receives the fixed rate under the swap agreement.

Investors can also use Swaptions to trade the volatility of the underlying swap rate.

However another important property of an option is it settlement type.

For Swaptions, there are two settlement type options – ***Physical or Cash***.

* **Physical Settlement** - the underlying swap is bought or sold.
* **Cash Settlement** - the difference between the strike rate and the rate for the underlying swap in the market at expiry (based on market swap rates) is determined to arrive at a cash payoff of the Swaption.

The settlement method for the Swaption is decided on the trade date and cannot be modified.

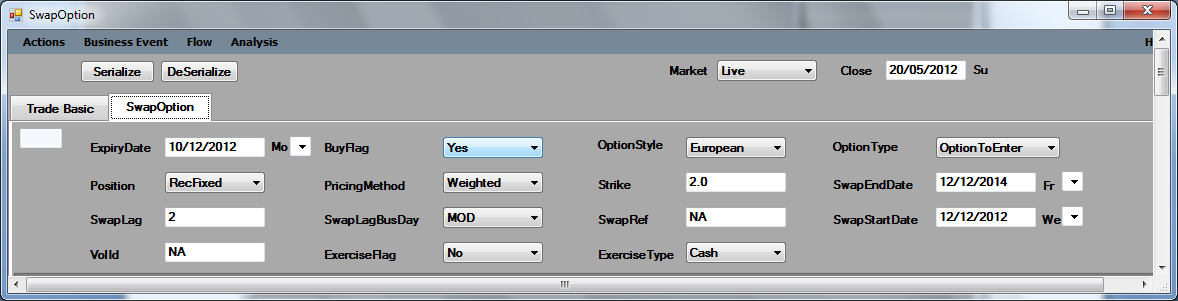
The majority of standard GBP and USD Swaptions are cash settled.

# Swaption Pricing Screen

The Swaption Pricing screen, like the IRD Cap/Floor pricing screen has three tabs associated with it.

|  |  |
| --- | --- |
| **Tab** | **Purpose** |
| ***OTC Info*** | Static non economic information |
| ***T&C Basic*** | Fundamental economic information about the swap – Tenor, Strike, Notional etc  Some information about the underlying swap |
| ***T&C Detail*** | All details in regard to the underlying swap  All fields and their options are per Swap Terms and Conditions screen |

# Terms and Conditions Basic



* **Type:** The type tab is used to indicate the type of the Swaption – i.e. European, American etc.

The type field is not clearly indicated, but where the European option is chosen in the above screen shot is where the drop down list to change the type is available. Selection of type will determine what fields on the pricing screen are available for selection, and also the editable/non- editable status of the fields.

* **Swap Type field:** This field only becomes enabled when a Swaption of type American is being trade captured. The swap type related to the start date of the underlying swap if the Swaption is exercised.
* **Constant Maturity:** the start date for the swap is the exercise date of the
* **Remaining Life:** the swap starts at the predetermined exercise date, irrelevant of when the Swaption is exercised.
* **Buy /Sell:** Specifies, from the Derivatives Connect perspective, whether the Swaption is bought or sold.
* **Pay Fixed/ Rec Fixed**

Pay Fixed is the call option

* *It results in a Payer Swaption, where, in the underlying swap, you wish to pay fixed and receive floating.*

Receive Fixed is the put option

* *It corresponds to a Receiver Swaption where you receive fixed and pay float.*
* **Expiry:** This is essentially the tenor for the Swaption – how long from trade date the option will expire.
* For European options, the only date that the Swaption can be exercised is

Trade Date + Expiry Strike

* For a payer Swaption, exercising the option when there is a physical settlement will mean that the underlying swap will be purchased with a fixed rate leg at the strike rate.
* **Notional**
* The notional in this case refers to the notional of the underlying swap.
* This notional is theoretical.
* The right hand side of the T&C basic panel has information about the underlying swap.
* **By**
* This field is used to indicate the tenor associated with the underlying swap.
* This tenor is important in terms of the notation used to describe a Swaption.
* If the expiry on a payer Swaption is one year and the by (tenor) of the underlying swap is two years, then the Swaption is termed as

1 year, two year payer swap

* **SD/ED**
* The Start Date (SD) field refers to the start date of the swap.
* The End Date is similarly the end date for the underlying swap.

*This right hand side panel has some basic information about the underlying swap*

* Settlement Frequency
* Day Count
* Rate

The exact details of the swap can be modified in the T&C detail panel.

# How IRD deals with Swaptions

* When a Swaption is created in IRD, it results in two instruments being created –

*The live Swaption and*

*The inactive underlying swap – its inactive status means that the swap doesn’t affect PNL.*

* Although until such time as the Swaption is exercised, the swap is only theoretical, an inactive swap for the Swaption does exist in IRD and is sent as part of the Swaption to downstream systems.
* The Swaption and the associated swap have different deal IDs, but the same deal Cover Ids. In terms of OASYS transactions numbers, the underlying swap is allocated the transaction number two, the Swaption itself having a transaction number of one.
* When the IRD Swaption is about to expire, the option traders, as a matter of course, enter IRD to deal with the Swaption.
* If the Swaption is out of the money, nothing is done – the live Swaption will be terminated by the batch.
* If the Swaption is in the money, then something must be done. If the Swaption is to be cash settled, as agreed in the exercise condition, then the counterparty is notified and the cash settlement ensues.
* If the Swaption is to be physically settled, then the user creates the swap by exercising.

# Premium Window

* In the introduction to options, the premium was discussed. As an option, the Swaption has an associated premium.
* To enter or view the premium, select Premium from the IRD ‘View’ menu option.
* When an option is sold, the premium will be *positive*.
* When the option is bought, the premium will be *negative*.

# Exercise Window

* As mentioned, a Swaption has two exercise options - Cash settlement and Physical settlement.
* This must be decided in advance and is detailed in the Exercise window.
* To view this, select the exercise menu of the ‘View’ menu option.
* The window is used to specify –

Settlement Type

Notification

Exercise Fee

* The exercise fee menu option details if an exercise fee should be paid, and if it should, who should pay it.

# Cancelable Swap

* An interesting use of Swaptions is in conjunction with a swap of the same length in order to create what is known as a cancelable swap.
* Assume the counterparty holds a 10-year swap on which they pay 5%.
* Normally if the counterparty wishes to prematurely end a swap, it will be necessary to unwind the swap at current market rates.
* Assume however that at the time of acquiring the swap, the counterparty also acquires a Bermudan Swaption with a 10-year expiry.
* The Swaption is a receiver Swaption, which has an option to receive 5% fixed.
* Assuming that the time when the counterparty wished to unwind the swap is suitable in terms of the fixed schedule of the Bermudan Swaption, then –
* Instead of unwinding the Swaption at current market rates, the counterparty can simply exercise the Swaption.
* This effectively unwinds the trade.
* A premium was paid for the Swaption at the time of purchase, but this is likely to be less than the cost of unwinding at current market rates.
* Thus the Swaption is used to create a cancelable swap.
* An advantage of this is when swaps are used to hedge a basket of bonds. If the bonds were sold on, the swaps are unnecessary and a cancelable swap is the most desirable option to unwind these swaps.

# Cap/Floors/Straddles

# Cap

An interest rate cap is actually a series of European interest call options (called caplets), with a particular interest rate, each of which expire on the date the floating loan rate will be reset. At each interest payment date the holder decides whether to exercise or let that particular option expire. In an interest rate cap, the seller agrees to compensate the buyer for the amount by which an underlying short-term rate exceeds a specified rate on a series of dates during the life of the contract. Interest rate caps are used often by borrowers in order to hedge against floating rate risk.

It’s a derivative in which the buyer receives payments at the end of each period in which the interest rate exceeds the agreed strike price. An example of a cap would be an agreement to receive a payment for each month the LIBOR rate exceeds 2.5%.

The interest rate cap can be analyzed as a series of European call options or caplets which exist for each period the cap agreement is in existence.

It protects you against interest rates rising while still allowing you to take advantage of the benefit of falling interest rates. It does this by setting an upper limit (or cap) on the floating interest rate, which you have to pay. It actually insures you against a borrowing cost greater than this 'capped' level. If the interest rate goes over this, we will pay you compensation. With this protection, you are then free to benefit from lower interest rates if they come about. A cap is in essence a simple Interest Rate product.

* A cap has a fixed and a floating rate associated with it.
* The fixed rate is the strike rate associated with the Cap.
* The float rate is the market index against which the strike will be compared on the quote days for the cap.
* The cap can have multiple periods and fixing of the rate is done at the start of each of the cap’s settlement periods (Caps, by default, reset in advance).
* Standard Caps make payment at the end of the settlement periods, if and only if the reset rate exceeds the strike rate.
* If the reset rate, *r*, exceeds the strike rate, *s*, the payoff from the cap is –

***(r –s) \* N \* Day count Fraction***

* Where N is the notional associated with the cap.
* If however the reset rate at the quote date is less than the strike rate, there will not be a payment made for that settlement period.
* A Cap, given its reset on the quote dates for each settlement period, is in like the floating leg of a swap.
* Each period, from the start to the end of a settlement period is called a Caplet.
* An important point to note however is the fact that the rate to be applied to the first Caplet is known in when the caplet is traded – the quote date for GBP and ZAR caps being trade date, for all other currencies, two days prior to trade date.
* Therefore the rate for the first Caplet of a Cap is said to *be historic and does not generate an associated cash flow*. In other words, market convention excludes the first caplet of a cap.

# Benefits of Cap

* The cap gives full protection against rising interest rates beyond the cap level.
* The cap gives you freedom to benefit from future falls in interest rates.
* If you pay off the loan, you can sell us back the Interest-Rate Cap and may receive some value.
* If the counterparty is paying floating on a notional, then they will purchase a cap.

# Features of Cap

* You can get an Interest-Rate Cap from a bank other than the one who gave you the original loan.
* The Interest-Rate Cap does not need to be based on a particular loan.
* You can use the cap for any loans you already have or expect to have.
* We provide Interest-Rate Caps in US Dollars and the other major currencies.
* We can arrange Interest-Rate Caps on Libor and also the BMA index
* We can arrange Interest-Rate Caps for different maturities.
* We usually pay compensation under an Interest-Rate Cap agreement at the end of each relevant floating period.
* You pay the premium for the Interest-Rate Cap up front.

# Floor

Floors are similar to caps in that they consist of a series of European interest put options (called caplets) with a particular interest rate, each of which expire on the date the floating loan rate will be reset. In an interest rate floor, the seller agrees to compensate the buyer for a rate falling below the specified rate during the contract period. A collar is a combination of a long (short) cap and short (long) floor, struck at different rates. The difference occurs in that on each date the writer pays the holder if the reference rate drops below the floor. Lenders often use this method to hedge against falling interest rates.

An **interest rate floor** is a series of European put options or **floorlets** on a specified reference rate, usually LIBOR. The buyer of the floor receives money if on the maturity of any of the floorlets; the reference rate fixed is below the agreed strike price of the floor.

An Interest-Rate Floor guarantees you a certain minimum rate of return on your deposit. If floating interest rates fall below this level, we will pay you compensation. At the same time, you are free to benefit from higher interest rates.

The difference with a floor keeping all caps terms similar is that if the reset rate is below the strike rate, then there will be a payout associated with the floorlet. If however, the reset rate is above the strike rate, there will not be any payment for that settlement period of the floor.

# Benefits of Floor

* The floor will give you a guaranteed minimum return on your cash.
* The floor will give you the freedom to take advantage of higher interest rates.
* If your cash balance is run down, you can sell us back the floor and you may receive some value depending on prevailing rates and the length of the remaining term.

# Features of Floor

* You can arrange an Interest-Rate Floor with any bank. It doesn't have to be the one where your cash is deposited.
* You can use the floor for deposits you already have or expect to receive.
* We can arrange Interest-Rate Floors for different maturities.
* We usually pay compensation at the end of each relevant Libor period when interest rates fall below the floor.
* You pay the premium for the Interest-Rate Floor up front
* The premium you pay will depend on:
  + - The guaranteed rate and the swap rate;
    - How long you want the floor for; and
    - How often interest rates are changing.

# Use of Caps and Floors

Variable rate borrowers are the typical users of Interest Rate Caps. They use Caps to obtain certainty for their business and budgeting process by setting the maximum interest rate they will pay on their borrowings. By implementing this type of financial management, variable rate borrowers obtain peace of mind from rising interest rates but retain the ability to benefit from any favorable interest rate movements.

Variable rate investors are the typical users of Interest Rate Floors. They use Floors to obtain certainty for their investments and budgeting process by setting the minimum interest rate they will receive on their investments. By implementing this type of financial management, variable rate investors obtain peace of mind from falling interest rates and the freedom to concentrate on other aspects of their business/investments.

* Caps and Floors are widely used as insurance policies.
* If the counterparty is ***paying floating on a notional, then they will purchase a cap***.
* If the counterparty is ***receiving floating, then they will purchase a floor***.

# Types of Caps and Floors

* **Digital Cap**
* In the case of a digital cap/floor, there is a predetermined payoff. An example is the best way to explain a digital cap.
* If a cap is agreed to have a strike of 5%, then the payoff if the market rate exceeds the strike must also be agreed.
* If the market exceeds the strike by 50 basis points or by one basis point, then the agreed payout must be made to the counterparty.
* In the case of a digital cap, the buyers upside is limited, but guaranteed. Similarly, the seller’s downside is limited.
* **Chooser Flex**
  + - Like any cap, a chooser flex based cap is made up as a series of caplets, the first caplet being excluded.
    - In a chooser flex, the cap holder must choose which caplets to receive a payout in and the number of caplets in which a payout can be received is limited in advance.
    - For example, a 10-year euro cap, with an annual frequency will have 9 settlement periods.
    - In a chooser flex, the user will have the option to exercise in only 4 of the 9 periods.
* **Auto Flex**

An auto flex cap or floor is similar to a chooser flex in that the number of periods in which payment will be received is limited.

However, in the case of an auto flex, the periods in which payment will be received is determined by a specified formula, i.e. – if the cap is in the money by 20 b.p., then it should be exercised.

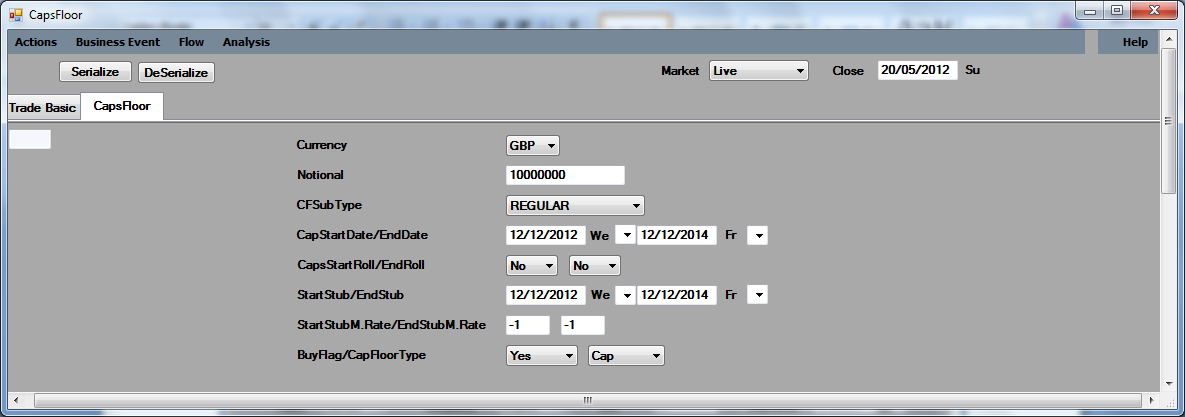
# Cap/Floor Pricing in IRD

The IRD cap/floor pricing screen has three information tabs associated with it –

|  |  |
| --- | --- |
| Tab | **Purpose** |
| ***OTC info*** | To capture static non economic details of the position |
| ***T & C Basis*** | To capture the basis economic information of the cap/floor   * For example – Notional , Strike rate |
| ***T & C Detail*** | To capture economic information such as day count and holiday convention.   * This panel usually defaults to the conventions of the currency and is rarely modified |

# T&C Basic

The most important in terms of capturing information about the Cap/Floor –



* **Cap/Floor:** This selection menu is used to indicate whether the instrument being booked is a cap or a floor. Because the basic concepts behind them are the same, the same screen can be used to book the two types of instruments.

### Buy/Sell: Indicates whether you are buying or selling the cap or floor.

### Tenor: The total period associated with the instrument.

### Start: The start date for the cap/floor.

### End: End date for the cap/floor.

### Amount: The notional associated with the cap/floor. Just as is the case with Swap, the notional is not exchanged for a cap or floor.

### Freq: The settlement frequency for the cap/floor.

### R. Freq: The frequency with which the rate is reset against the specified market index.

### Strike: The fixed rate associated with the cap or floor.

The difference between the strike and the reset rate at each settlement period determines the rate used to calculate cash flows.

### Ref. Index: The market index against which the rate will be reset at 11.00 a.m. on the quote date.

* + - The market index chosen should correspond to the frequency of the cap.
    - For example, an appropriate reference rate for a semi annual Euro cap is EURIBOR\_6M.
    - An important point of note is that the numbers which follow the name of the reference index are a feature of IRD. For example – EUROBO\_6M.T248.
    - These numbers refer to the Telerate page that is used throughout the industry to determine the rate resets.

### Basis: Describes the day count convention applicable to the cash flow calculations.

Again, the day count defaults are appropriated based on the currency of the cap/floor.

### Reset/Pay: This menu allows the end user to specify whether reset and payment will occur in advance or in arrears.

The standard for caps and floors is to *reset in advance and pay in arrears* i.e. Adv/Arr option.

### Type: The type drop down menu offers a significant list of different types of caps and floors for selection.

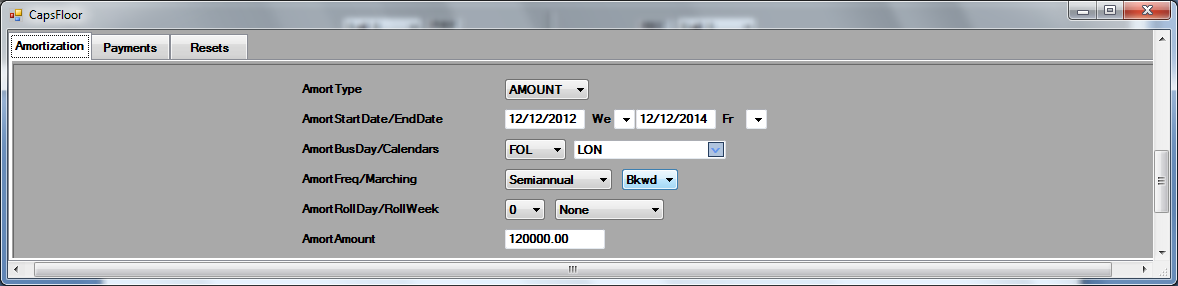
The vast majority of the caps and floors entered in IRD are standard and vanilla – Murex being used for the capture of exotic caps and floors.

# T&C Details

The most important in terms of capturing information about the Cap/Floor –

This tab, as mentioned, is used to capture more details about the strike such as business day convention, Amortization etc.

In general, the defaults on this panel are accepted as standard and are rarely changed. The purpose of the fields in this detail panel and the significance of their various options have already been discussed previously.



# Straddles

A **straddle** is an investment strategy involving the purchase or sale of particular option derivatives that allows the holder to profit based on how much the price of the underlying security moves, regardless of the *direction* of price movement. The purchase of particular option derivatives is known as a **long straddle,** while the sale of the option derivatives is known as a **short straddle**.

An options strategy with which the investor holds a position in both a call and put with the same strike price and expiration date.

Straddles are a good strategy to pursue if an investor believes that a stock's price will move significantly, but is unsure as to which direction. The stock price must move significantly if the investor is to make a profit. A straddle is extremely risky to perform. Additionally, on stocks that are expected to jump, the market tends to price options at a higher premium, which ultimately reduces the expected payoff should the stock move significantly.

**Long Straddle:** A long straddle involves going long, i.e., purchasing, both a call option and a put option on some stock, interest rate, index or other underlying. The two options are bought at the same strike price and expire at the same time. The owner of a long straddle makes a profit if the underlying price moves a long way from the strike price, either above or below. Thus, an investor may take a long straddle position if he thinks the market is highly volatile, but does not know in which direction it is going to move. This position is a limited risk, since the most a purchaser may lose is the cost of both options. At the same time, there is unlimited profit potential.

**Short straddle**: A short straddle is a non-directional options trading strategy that involves simultaneously selling a put and a call of the same underlying security, strike price and expiration date. The profit is limited to the premiums of the put and call, but it is risky if the underlying security's price goes up or down much. The deal breaks even if the intrinsic value of the put or the call equals the sum of the premiums of the put and call. This strategy is called "nondirectional" because the short straddle profits when the underlying security changes little in price before the expiration of the straddle. The short straddle can also be classified as a credit spread because the sale of the short straddle results in a credit of the premiums of the put and call.

# FRAs

A forward rate agreement (FRA) is an OTC derivative instrument that trades as part of the money markets. It is essentially a forward-starting loan, but with no exchanges of principal, so that only the difference in interest rates is traded. An FRA is a forward-dated loan, dealt at a fixed rate, but with no exchange of principal – only the interest applicable on the notional amount between the rate dealt and the actual rate prevailing at the time of settlement changes hands. So FRA’s are off-balance sheet (OBS) instruments. By trading today at an interest rate that is effective at some point in the future, FRAs enable banks and corporate to hedge interest rate exposure. They may also be used to speculate on the level of future interest rates.

Money market derivatives are priced on the basis of the forward rate, and are flexible instruments for hedging against or speculating on forward interest rates. The FRA and the exchange-traded interest rate future both date from around the same time, and although initially developed to hedge forward interest rate exposure, they now have a variety of uses. In this article the FRA is introduced and analyzed, and we review its main uses.

# Definition

An FRA is an agreement to borrow or lend a notional cash sum for a period of time lasting up to twelve months, starting at any point over the next twelve months, at an agreed rate of interest (the FRA rate). The “buyer” of an FRA is borrowing a notional sum of money while the “seller” is lending this cash sum. Note how this differs from all other money market instruments. In the cash market, the party buying a CD or bill, or bidding for stock in the repo market, is the lender of funds. In the FRA market, to “buy” is to “borrow”. Of course, we use the term “notional” because with an FRA no borrowing or lending of cash actually takes place, as it is an off-balance sheet product. The notional sum is simply the amount on which interest payment is calculated.

So when an FRA is traded, the buyer is borrowing (and the seller is lending) a specified notional sum at a fixed rate of interest for a specified period, the “loan” to commence at an agreed date in the future. The buyer is the notional borrower, and so if there is a rise in interest rates between the date that the FRA is traded and the date that the FRA comes into effect, she will be protected. If there is a fall in interest rates, the buyer must pay the difference between the rate at which the FRA was traded and the actual rate, as a percentage of the notional sum. The buyer may be using the FRA to hedge an actual exposure, that is an actual borrowing of money, or simply speculating on a rise in interest rates. The counterparty to the transaction, the seller of the FRA, is the notional lender of funds, and has fixed the rate for lending funds. If there is a fall in interest rates the seller will gain, and if there is a rise in rates the seller will pay. Again, the seller may have an actual loan of cash to hedge or be a speculator.

In FRA trading only the payment that arises as a result of the difference in interest rates changes hands. There is no exchange of cash at the time of the trade. The cash payment that does arise is the difference in interest rates between that at which the FRA was traded and the actual rate prevailing when the FRA matures, as a percentage of the notional amount. FRAs are traded by both banks, corporate and between banks. The FRA market is very liquid in all major currencies and rates are readily quoted on screens by both banks and brokers. Dealing is over the telephone or over a dealing system such as Reuters.

The terminology quoting FRAs refers to the borrowing time period and the time at which the FRA comes into effect (or matures). Hence if a buyer of an FRA wished to hedge against a rise in rates to cover a three-month loan starting in three months’ time, she would transact a “three-against-six month” FRA, or more usually a 3 × 6 or 3-v-6 FRA. This is referred to in the market as a “threes-sixes” FRA, and means a three-month loan beginning in three months’ time. So a “ones-fours” FRA (1-v-4) is a three-month loan in one month’s time, and a “threes-nines” FRA (3-v-9) is six-month money in three months’ time.

Note that when one buys an FRA one is “borrowing” funds. This differs from cash products such as CD or repo, as well as interest rate futures, where “buying” is lending funds.

# FRA Mechanics

In virtually every market worldwide, FRAs trade under a set of terms and conventions that are identical. The British Bankers’ Association (BBA) has compiled standard legal documentation to cover FRA trading. The following standard terms are used in the market.

**Notional sum:** The amount for which the FRA is traded.

**Trade date:** The date on which the FRA is dealt.

**Settlement date:** The date on which the notional loan or deposit of funds becomes effective, that is, is said to begin. This date is used, in conjunction with the notional sum, for calculation purposes only as no actual loan or deposit takes place.

**Fixing date:** This is the date on which the reference rate is determined, that is, the rate to which the FRA dealing rate is compared.

**Maturity date:** The date on which the notional loan or deposit expires.

**Contract period:** The time between the settlement date and maturity date.

**FRA rate:** The interest rate at which the FRA is traded.

**Reference rate:** This is the rate used as part of the calculation of the settlement amount, usually the LIBOR rate on the fixing date for the contract period in question.

**Settlement sum:** The amount calculated as the difference between the FRA rate and the reference rate as a percentage of the notional sum, paid by one party to the other on the settlement date.

These terms are illustrated in Figure 1.



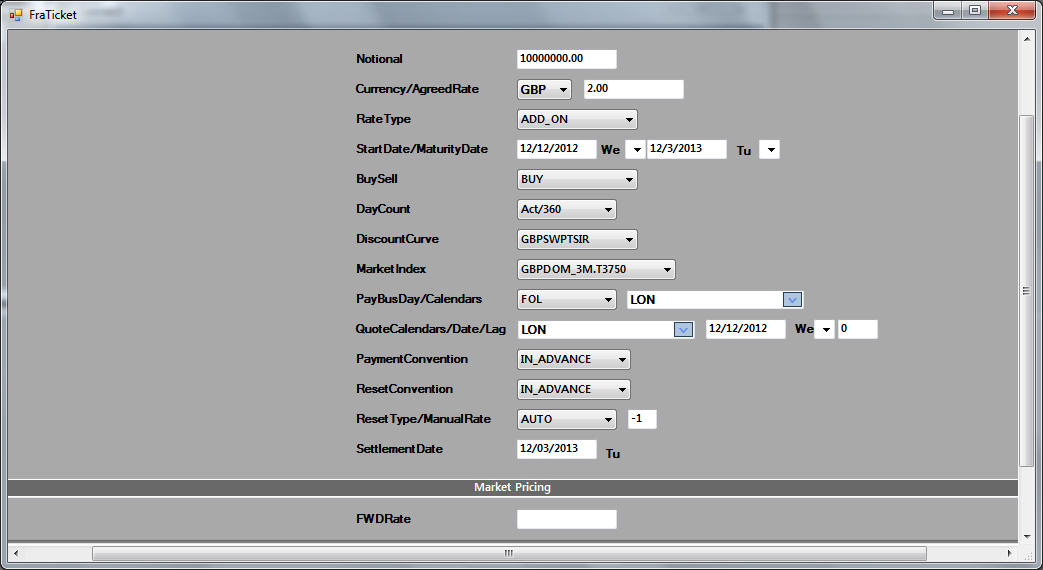
**Figure 1:** Key dates in an FRA trade

The spot date is usually two business days after the trade date, however it can by agreement be sooner or later than this. The settlement date will be the time period after the spot date referred to by the FRA terms, for example a 1 × 4 FRA will have a settlement date one calendar month after the spot date. The fixing date is usually two business days before the settlement date. The settlement sum is paid on the settlement date, and as it refers to an amount over a period of time that is paid up front, at the start of the contract period, the calculated sum is discounted present value. This is because a normal payment of interest on a loan/deposit is paid at the end of the time period to which it relates; because an FRA makes this payment at the *start* of the relevant period, the settlement amount is a discounted present value sum.

With most FRA trades the reference rate is the LIBOR fixing on the fixing date.

The settlement sum is calculated after the fixing date, for payment on the settlement date.

# FRA Pricing: Terms & Conditions Screen



###### **Tenor**

* The tenor field uses the notation describes in the above section to indicate when the FRA will start and how long the FRA will last.

###### **Notional**

* The principle associated with the FRA.
* The principal will be the same for the fix and the float leg of the FRA.
* As is the case with Swaps, the notional is only theoretical and is not exchanged.

**Currency**

* Used to indicate the currency of the notional.

**Ref Index**

* The reference index is the market index against which the rate for the floating leg will be reset on the quote day for FRA.

**Agreed Rate**

* This is the fixed rate for the fixed leg.

**Quote Date**

* The quote date is the same as in Swaps. For all swaps other then GBP and ZAR, the quote day will precede the start date for the FRA by two days with a resultant lag of –2.
* For GBP and ZAR FRA’s the quote date is the same as the start date.

**Quote Hol / Settle Hol**

* These conventions determine which dates will be considered as holidays.
* The holiday convention is determined by the currency of the notional.

**Start Date**

The start date is the start date for the FRA’s single period

Payment Date

* The fact the FRA payments are made at the start of the settlement period is a key features of FRAs.
* This feature means that the Payment Date is always the same as the Start Date for the FRA.
* An important point of note is that in IRD, once the payment associated with the FRA has been made, the FRA is marked as gone.
* This means that the FRA is no longer live even though its maturity date has not yet been reached.

**Maturity Date**

* The end of the settlement period for the FRA.

**Reset Rate**

* The rate of the chosen market index on the quote date.

**Reset & Bus Day & Day count**

* These fields and their options have the same meaning in the FRA screen as in the IRD Swap Pricing Screen.

**Discount TSId**

* This is the name of the futures curve which is used to price the FRA.
* The below panel provides important information when the FRA is originally being booked.
* The FFWD Rate is the rate that IRD predicts for the quote date of the swap – the rate is predicted based on information from the Portfolio Yield curve screen.
* Provided deal is live, the PV field in this panel will show the PV for the FRA deal.

As their name implies, FRAs are forward rate instruments and are priced using forward rate principles. Consider an investor who has two alternatives, either a six-month investment at 5% or a one-year investment at 6%. If the investor wishes to invest for six months and then roll over the investment for a further six months, what rate is required for the rollover period such that the final return equals the 6% available from the one-year investment? If we view an FRA rate as the breakeven forward rate between the two periods, we simply solve for this forward rate and that is our approximate FRA rate. This rate is sometimes referred to as the interest rate “gap” in the money markets (not to be confused with an interbank desk’s *gap risk*, the interest rate exposure arising from the net maturity position of its assets and liabilities).

We can use the standard forward-rate breakeven formula to solve for the required FRA rate; we established this relationship earlier when discussing the calculation of forward rates that are arbitrage-free. The relationship given in equation (2) connects simple (bullet) interest rates for periods of time up to one year, where no compounding of interest is required. As FRAs are money market instruments we are not required to calculate rates for periods in excess of one year,1 where compounding would need to be built into the equation. This is given by equation (2)

(1+R2T2) = (1+R1T1)(1+RfTf))

Where

* R2 is the cash market interest rate for the long period;
* R1 is the cash market interest rate for the short period;
* Rf is the forward rate for the gap period;
* T2 is the time period from today to the end of the long period;
* T1 is the time period from today to the end of the short period;
* Tf is the forward gap time period, or the contract period for the FRA.

This is illustrated diagrammatically in Figure 2.



The time period *t*1 is the time from the dealing date to the FRA settlement date, while *t*2 is the time from the dealing date to the FRA maturity date. The time period for the FRA (contract period) is *t*2 minus *t*1.

In practice FRAs are priced off the exchange-traded short-term interest rate future for that currency, so that sterling FRAs are priced off LIFFE short sterling futures. Traders normally use a spreadsheet pricing model that has futures prices directly fed into it. FRA positions are also usually hedged with other FRAs or short-term interest rate futures.

# Some Examples on FRAs

**Example 1:**

A company knows that it will need to borrow £1 million in three months’ time for a twelve-month period. It can borrow funds today at LIBOR + 50 basis points. LIBOR rates today are at 5% but the company’s treasurer expects rates to go up to about 6% over the next few weeks. So the company will be forced to borrow at higher rates unless some sort of hedge is transacted to protect the borrowing requirement. The treasurer decides to buy a 3-v-15 (“threes-fifteens”) FRA to cover the twelve-month period beginning three months from now. A bank quotes 5½% for the FRA which the company buys for a notional £1 million. Three months from now rates have indeed gone up to 6%, so the treasurer must borrow funds at 6½% (the LIBOR rate plus spread), however she will receive a settlement amount which will be the difference between the rate at which the FRA was bought and today’s twelve-month LIBOR rate (6%) as a percentage of £1 million, which will compensate for some of the increased borrowing costs.

### Example 2: Hedging an FRA position

An FRA market maker sells a EUR 100 million 3-v-6 FRA, that is, an agreement to make a notional deposit (without exchange of principal) for three months in three months’ time, at a rate of 7.52%. He is exposed to the risk that interest rates will have risen by the FRA settlement date in three months’ time.

Date 14 December

* 3-v-6 FRA rate 7.52%
* March futures price 92.50%
* Current spot rate 6.85%

**Action:**

The dealer first needs to calculate a precise hedge ratio. This is a three-stage process:

1. Calculate the nominal value of a basis point move in LIBOR on the FRA settlement payment;

BPV = FRAnom\*0.01% \* (n/360)

Therefore: €100,000,000×0.01%×90/360= €2500.

1. Find the present value of 1. By discounting it back to the transaction date using the FRA and spot rates;

Present value of a basis point move=

Nominal value of basis point

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

{1+spot rate\*(Days in Hedge Period/360)} {1+FRA rate\*(Days In hedgePeriod/360)}

1. Determine the correct hedge ratio by dividing 2 by the futures tick value.

Hedge Ratio = 2412/25



The appropriate number of contracts for the hedge of a EUR 100,000,000 3-v-6 FRA would therefore be 96 or 97, as the fraction is under one-half, 96 is correct. To hedge the risk of an increase in interest rates, the trader sells 96 ECU three months' futures contracts at 92.50. Any increase in rates during the hedge period should be offset by a gain realised on the futures contracts through daily variation margin receipts.

**Outcome**

Date 15 March

* Three month LIBOR 7.625%
* March EDSP 92.38

The hedge is lifted upon expiry of the March futures contracts. Three-month LIBOR on the FRA settlement date has risen to 7.625% so the trader incurs a loss of EUR 25,759 on his FRA position (i.e., EUR 26,250 discounted back over the three month FRA period at current LIBOR rate), calculated as follows:

(LIBOR-FRA rate)×(daysinFRAperiod/360)×Contract Nominal Amount

1+LIBORrate × (daysinFRAperiod/360)

Futures P/L: 12 ticks (92.50-92.38)× €25×96 contracts = EUR 28,800.

The EUR 25,759 loss on the FRA position is more than offset by the EUR 28,800 profit on the futures position when the hedge is lifted. If the dealer has sold 100 contracts his futures profit would have been EUR 30,000, and, accordingly, a less accurate hedge. The excess profit in the hedge position can mostly be attributed to the arbitrage profit realised by the market maker (i.e., the market maker has sold the FRA for 7.52% and in effect bought it back in the futures market by selling futures at 92.50 or 7.50% for a 2 tick profit.)

# Exchange Traded Products Supported in IRD

An exchange-traded fund (or ETF) (also known as Exchange-Traded Product (ETP)) is an investment fund traded on stock exchanges, much like stocks. An ETF holds assets such as stocks or bonds and trades at approximately the same price as the net asset value of its underlying assets over the course of the trading day.

Only so-called *authorized participants* (typically, large institutional investors) actually buy or sell shares of an ETF directly from/to the fund manager, and then only in *creation units*, large blocks of tens of thousands of ETF shares, which are usually exchanged in-kind with *baskets* of the underlying securities. Authorized participants may wish to invest in the ETF shares long-term, but usually act as market makers on the open market, using their ability to exchange creation units with their underlying securities to provide liquidity of the ETF shares and help ensure that their intraday market price approximates to the net asset value of the underlying assets. Other investors, such as individuals using a retail broker, trade ETF shares on this secondary market.

An ETF combines the valuation feature of a mutual fund or unit investment trust, which can be bought or sold at the end of each trading day for its net asset value, with the tradability feature of a closed-end fund, which trades throughout the trading day at prices that may be more or less than its net asset value.

ETFs offer public investors an undivided interest in a pool of securities and other assets and thus are similar in many ways to traditional mutual funds, except that shares in an ETF can be bought and sold throughout the day like stocks on a securities exchange through a broker-dealer. Unlike traditional mutual funds, ETFs do not sell or redeem their individual shares at net asset value, or NAV. Instead, financial institutions purchase and redeem ETF shares directly from the ETF, but only in large blocks, varying in size by ETF from 25,000 to 200,000 shares, called "creation units". Purchases and redemptions of the creation units generally are in kind, with the institutional investor contributing or receiving a basket of securities of the same type and proportion held by the ETF, although some ETFs may require or permit a purchasing or redeeming shareholder to substitute cash for some or all of the securities in the basket of assets.

The ability to purchase and redeem creation units gives ETFs an arbitrage mechanism intended to minimize the potential deviation between the market price and the net asset value of ETF shares. Existing ETFs have transparent portfolios, so institutional investors will know exactly what portfolio assets they must assemble if they wish to purchase a creation unit, and the exchange disseminates the updated net asset value of the shares throughout the trading day, typically at 15-second intervals.

If there is strong investor demand for an ETF, its share price will (temporarily) rise above its net asset value per share, giving arbitrageurs an incentive to purchase additional creation units from the ETF and sell the component ETF shares in the open market. The additional supply of ETF shares increases the ETF's market capitalization and reduces the market price per share, generally eliminating the premium over net asset value. A similar process applies when there is weak demand for an ETF and its shares trade at a discount from net asset value.

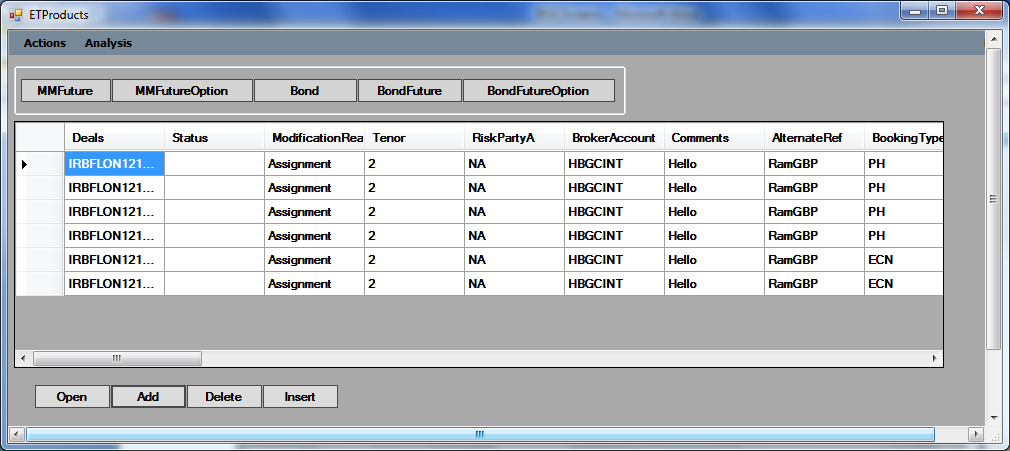
In the United States, most ETFs are structured as open-end management investment companies (the same structure used by mutual funds and money market funds), although a few ETFs, including some of the largest ones, are structured as unit investment trusts. ETFs structured as open-end funds have greater flexibility in constructing a portfolio and are not prohibited from participating in securities lending programs or from using futures and options in achieving their investment objectives.

Under existing regulations, a new ETF must receive an order from the Securities and Exchange Commission, or SEC, giving it relief from provisions of the Investment Company Act of 1940 that would not otherwise allow the ETF structure. In 2008, however, the SEC proposed rules that would allow the creation of ETFs without the need for exemptive orders. Under the SEC proposal, an ETF would be defined as a registered open-end management investment company that:

* + - Issues (or redeems) creation units in exchange for the deposit (or delivery) of basket assets the current value of which is disseminated on a per share basis by a national securities exchange at regular intervals during the trading day;
    - Identifies itself as an ETF in any sales literature;
    - Issues shares that are approved for listing and trading on a securities exchange;
    - Discloses each business day on its publicly available web site the prior business day's net asset value and closing market price of the fund's shares, and the premium or discount of the closing market price against the net asset value of the fund's shares as a percentage of net asset value; and
    - Either is an index fund, or discloses each business day on its publicly available web site the identities and weighting of the component securities and other assets held by the fund

**Exchange Traded Products screen Details:**

**Status:** Identifies current status of order.



**Contract:** Identifies the contract information.

**Product:** Describes the ETF product type viz- Bond Futures, Bond Future Options, Money Market Futures, Money Market future Options.

**Buy:** Identifies Notional value at Buyer side.

**Sell:** Identifies Notional value at seller side.

**Trade Price:** Identifies Principal value of the trade.

**Hedge Ref:** a transaction or position taken in order to eliminate or mitigate the risk of adverse price movements in an exposure position such as an existing asset or liability position**.**

**Exec Broker:** Unique broker of execution message as assigned by sell-side (broker, exchange, ECN) Uniqueness must be guaranteed within a single trading day or the life of a multi-day order. Money Market Futures.

**Trade Date:** Indicates date of trade referenced in this message in YYYYMMDD format. Absence of this field indicates current day (expressed in local time at place of trade).

**Book:** Common reference passed to a post-trade booking process.

A **futures contract** is a standardized contract between two parties to buy or sell a specified asset of standardized quantity and quality at a specified future date at a price agreed today (the *futures price*). The contracts are traded on a futures exchange. Futures contracts are not "direct" securities like stocks, bonds, rights or warrants. They are still securities, however, though they are a type of derivative contract. The party agreeing to buy the underlying asset in the future assumes a long position, and the party agreeing to sell the asset in the future assumes a short position.

The price is determined by the instantaneous equilibrium between the forces of supply and demand among competing buy and sell orders on the exchange at the time of the purchase or sale of the contract.

In many cases, the underlying asset to a futures contract may not be traditional "commodities" at all – that is, for *financial futures*, the underlying asset or item can be currencies, securities or financial instruments and intangible assets or referenced items such as stock indexes and interest rates.

The future date is called the *delivery date* or *final settlement date*. The official price of the futures contract at the end of a day's trading session on the exchange is called the *settlement price* for that day of business on the exchange...

A closely related contract is a forward contract; they differ in certain respects. Future contracts are very similar to forward contracts, except they are exchange traded and defined on standardized assets. Unlike forwards, futures typically have interim partial settlements or "true-ups" in margin requirements - such that the parties do not exchange additional property securing the party at gain and the entire unrealized gain or loss builds up while the contract is open.

A futures contract gives the holder the *obligation* to make or take delivery under the terms of the contract, whereas an option grants the buyer the *right,* but *not the obligation,* to establish a position previously held by the seller of the option. In other words, the owner of an options contract *may* exercise the contract, but both parties of a "futures contract" *must* fulfill the contract on the settlement date. The seller delivers the underlying asset to the buyer, or, if it is a cash-settled futures contract, then cash is transferred from the futures trader who sustained a loss to the one who made a profit. To exit the commitment prior to the settlement date, the holder of a futures position has to offset his/her position by either selling a long position or buying back (covering) a short position, effectively closing out the futures position and its contract obligations.

Futures contracts, or simply *futures*, (but not *future* or *future contract*s) are exchange traded derivatives. The exchange's clearing house acts as counterparty on all contracts, sets margin requirements, and crucially also provides a mechanism for settlement.

Futures contracts ensure their liquidity by being highly standardized, usually by specifying:

* The underlying asset or instrument. This could be anything from a barrel of crude oil to a short term interest rate.
* The type of settlement, either cash settlement or physical settlement.
* The amount and units of the underlying asset per contract. This can be the notional amount of bonds, a fixed number of barrels of oil, units of foreign currency, the notional amount of the deposit over which the short term interest rate is traded, etc.
* The currency in which the futures contract is quoted.
* The grade of the deliverable. In the case of bonds, this specifies which bonds can be delivered. In the case of physical commodities, this specifies not only the quality of the underlying goods but also the manner and location of delivery.
* The delivery month.
* The last trading date.
* Other details such as the commodity tick, the minimum permissible price fluctuation.

## *Futures vs forwards*

While futures and forward contracts are both contracts to deliver an asset on a future date at a prearranged price, they are different in two main respects:

* Futures are **exchange-traded,** while forwards are traded **over-the-counter.**

Thus futures are **standardized** and face an **exchange,** while forwards are **customized** and face non-exchange **counterparty.**

* Futures are margined, while forwards are not.

Thus futures have significantly less **credit risk,** and have different funding.

# Money Market Future Options

In many cases, *options* are traded on futures, sometimes called simply "futures options". A put is the option to sell a futures contract, and a call is the option to buy a futures contract. For both, the option strike price is the specified futures price at which the future is traded if the option is exercised.

Options are contracts that give their buyers the right, but not the obligation, to buy or sell a specified item at a set price within some predetermined time period. Options on futures contracts, known as futures options, are standardized option contracts traded on futures exchanges. Although an active over-the-counter market in stock options has existed in the United States for almost a century, the advent of exchange-traded options is a more recent development. Standardized options began trading on organized exchanges in 1973, when the Chicago Board Options Exchange (CBOE) was organized. The American and Philadelphia Stock Exchanges soon followed suit by listing stock options in 1975, followed one year later by the Pacific Stock Exchange. Today a wide variety of options trade on virtually all major stock and futures exchanges, including stock options, foreign currency options, and futures options.

Trading in futures options takes place in trading areas, or pits, situated next to the trading pits for the underlying futures contracts. A buyer who exercises a futures call option assumes a long futures position by buying the underlying futures contract at the strike price. The writer, in turn, must take on a corresponding short futures position by selling the underlying futures contract at the same price. The reverse holds true with futures put options. Exercising a futures put option creates a short futures position for the holder and a corresponding long position in the underlying contract for the writer. The resulting futures position can be liquidated through an offsetting futures transaction. When an option on a futures contract expires on the same day the underlying futures contract matures, exercising a futures option at expiration is equivalent to exercising an option on an actual cash item.

The principal advantage of futures options over options on physicals stems from the fact that most traders find delivery requirements less burdensome for futures options than options on actual physical items. Futures markets tend to be more liquid and have lower transactions costs than underlying cash markets. Thus, while the exercise of an option on an actual cash item requires the writer to buy or deliver that item, the exercise of a futures option results only in a long or short futures position, which is easy to offset. Such considerations are especially important to put and call writers, most of whom sell options in order to earn premium income rather than to buy or sell the underlying item

# Bond Futures

A bond future is a contractual obligation for the contract holder to purchase or sell a bond on a specified date at a predetermined price. A bond future can be bought in a futures exchange market and the prices and dates are determined at the time the future is purchased.

Bond contracts are standardized, and are overseen by a regulatory agency that ensures a certain level of equality and consistency. However, this form of derivative can be risky because it involves trading at a future date with only current information. The risk is potentially unlimited, for either the buyer or seller of the bond because the price of the underlying bond may change drastically between the exercise date and the initial agreement.

Being exchange traded, the future contracts regulate all participants enforcing settlement and margin payments. Most of the contracts are not settled at expiry and either they get rolled over or they get closed out - hence it is not important to take positions in the underlying. Therefore the parties are able to short sell as well as take long positions bigger than what they could take in the physical market. Futures have different underlying tenors such as five yr, 10 yr and so on. Also, futures of next few expiry dates are traded simultaneously. This enables rolling of contracts into the next period easily. It is literally impossible to deliver an exact 10 year or a specific time maturity bond as they are issued or auctioned at different times depending on debt requirements of the governments. Therefore the futures contracts are either cash settled based on a calculation method or have a delivery grade*3* for physical settlement. They are used for speculation in interest rates as well for hedging various loan portfolios.

# Bond Future Options

An option traded on a regulated exchange where the terms of each option are standardized by the exchange. The contract is standardized so that underlying asset, quantity, expiration date and strike price are known in advance. Over-the-counter options are not traded on exchanges and allow for the customization of the terms of the option contract.

* All terms are standardized except price.
* The exchange establishes expiration date and expiration prices as well as minimum price quotation unit.
* The exchange also establishes whether the option is American or European, its contract size and whether settlement is in cash or in the underlying security.
* Usually trade in lots in which 100 shares of stock = 1 option
* The most active options are the ones that trade at the money, while deep-in-the-money and deep-out-of-the money options don't trade very often.
* Usually have short-term expirations (one to six months out in duration) with the exception of LEAPS, which expire years in the future
* Can be bought and sold with ease and holder decides whether or not to exercise. When options are in the money or at the money they are typically exercised.
* Most have to deliver the underlying security.
* Regulated at the federal level

# Bond Options

An option contract in which the underlying asset is a bond. Other than the different characteristics of the underlying assets, there is no significant difference between stock and bond options. Just as with other options, a bond option allows investors to hedge the risk of their bond portfolios or speculate on the direction of bond prices with limited risk.

A buyer of a bond call option is expecting a decline in interest Rates and an increase in bond prices. The buyer of a put bond option is expecting an increase in interest rates and a decrease in bond prices.

Like other options, an option on a futures contract is the right but not the obligation, to buy or sell a particular futures contract at a specific price on or before a certain expiration date. These grant the right to enter into a futures contract at a fixed price.

A call option gives the holder (buyer) the right to buy (go long) a futures contract at a specific price on or before an expiration date. The holder of a put option has the right to sell (go short) a futures contract at a specific price on or before the expiration date.

# Conclusion

ETFs have a lot to offer. They're flexible and low-cost, and their underlying portfolios are protected from the impact of investor trading, making them more tax-efficient than most mutual funds. There are also ETFs that address specific sub sectors that regular mutual funds do not.

ETFs' cost advantage isn't always as large as it might seem, and trading costs can quickly add up. Particularly if you're in the market for a fund that tracks a broad index such as the NSE Nifty, or if you wish to invest regular sums of money, it's tough to make a case yet for choosing an ETF over one of the existing low-cost mutual-fund options.

**Advantages**

* **Trading Flexibility**

One key advantage that ETFs have over traditional mutual funds is trading flexibility. ETFs trade throughout the day, so you can buy and sell them when you want.

* **Costs**

In terms of the annual expenses charged to investors, ETFs are considerably less expensive than the vast majority of mutual funds.

* **Performance**

Because they are shielded from investor trading, ETFs shouldn't suffer from having to keep cash on hand to meet redemptions, or from being forced to sell stocks into a declining market for the same purpose.

# Miscellaneous

* 1. **Appendix A - References**
  2. **Appendix B - Glossary of Terms**

**Accrual Bond** - a bond on which interest accrues, but is not paid to the investor during the time of accrual. The amount of accrued interest is added to the principal of the bond and is paid at maturity.

**Actuals** - the physical commodity underlying a futures contract. Also referred to as the cash commodity or the physicals.

**Algorithm** - a defined, finite set of steps, operations, or procedures that will produce a particular outcome (e.g. computer programs, mathematical formulas, and recipes).

**Alpha** - a measure of the difference between a fund's actual returns and its expected returns given its risk level as measured by its **Beta**. The Alpha is a measure of risk adjusted performance. An Alpha is usually generated by regressing the security, portfolio or mutual fund's excess return on the S&P 500 excess return. The Beta adjusts for the risk (the slope coefficient). The Alpha is the intercept and is also know as the **Jensen Index**.

**American Option** - an option contract that may be exercised at any time prior to expiration. This differs from a **European Option**, which may only be exercised on the expiration date.

**Annualized Return** - a return calculated over one period, but adjusted to be comparable to a return calculated over a year.

**Application ID**: Used interchangeably with Mystic ID. This is the application ID in Derivatives Connect Systems Inventory (DCSI).

**Arbitrage** - a trading and investment technique to cash-in on price differences between related markets, indices, or futures contracts based on those indices.

**ARCH** - an acronym for autoregressive conditional **heteroskedasticity**.

**Arithmetic Mean** - the sum of a list of numbers, divided by the number of numbers. See also Average below.

**Asset Allocation** - an investment strategy based on allocation of percentages of an investment portfolio between stocks, bonds, or other asset classes.

**Asset Value Model** A model for assessing the credit risk of corporate debt.

**Asian Option** - an exotic option whose payoff depends on the price movements of the underlying asset during some portion of the life of the option.

**Autocorrelation** - the **correlation** between a component of a stochastic process and itself lagged a certain period of time.

**Average** - usually denotes the arithmetic mean (see above), but it can also denote the median, the mode, the geometric mean, and weighted means, among other things.

**Average Price Option** - an average rate option; see below. Also referred to as an APO.

**Average Rate Option** - a form of Asian option whose payoff is linked to the average underlier value over a specified period. Although somewhat more complex to price relative to traditional European or American option structures, Average Rate Options are popular since they provide a price hedge that better matches price exposures that are based on daily averages, such as purchase/consumption of energy on a daily basis.

**Backwardation** - market situation in which futures prices are progressively lower in the distant delivery months.

**Barrier Option** - a path-dependent option that terminates or is activated by the underlier reaching some "barrier" price level.

**Basis Point** - 1/100th of 1%.

**Basis Risk** - the risk of financial loss due to a change in the price differential between the hedge index and the underlying cash price. Basis risk typically involves product, location or time differences.

**Basis Swap** A floating-for-floating interest rate or currency swap.

**Bayes Rule** - a rule that expresses the conditional probability of the event A given the event B in terms of the conditional probability of the event B given the event A.

**Bell Curve** - a common description of the characteristic shape of the most common of statistical distributions: the **Normal distribution**.

**Below Investment Grade Bond** - a junk bond, whose credit rating is below BBB.

**Bermuda Option** - an option that allows exercise at discrete points in time after a certain date. Also known as a modified American option. See American, European and Asian options.

**Bernouilli Process** - the simplest probability model - a single trial between two possible outcomes, such as a coin toss.

**Beta** - a measure of a stock's (or a portfolio's) volatility in relation to the overall market, which by definition has a beta of 1.0.

**Bid-Ask Spread** - the difference between prices at which dealers are willing to buy or sell. Also referred to as the Bid-Offer

**Binary Option** - a type of option which features a discontinuous expiration value.

**BIS** - an acronym for the Bank for International Settlements. The BIS is an international body that promotes the cooperation of central banks, fulfils the function of a central banks' bank and acts as a clearing and settlement agent. The BIS also acts as a forum for discussion of international monetary policy and conducts research into international banking developments.

**Black-Derman-Toy Model (BDT)** - an options pricing model using the Black/Derman/Toy binomial interest rate model. This model is a set of simultaneous nonlinear equations. It is named after the late Fischer Black, Dr. Emanuel Derman of Goldman, Sachs & Co. and William Toy, who developed the model in 1987.

**Black-Scholes Model** - an options pricing formula first developed in 1973 by Fisher Black and Myron Scholes for securities options and later applied to a range of other option structures.

**Blue Sky Laws** - laws various states have enacted to protect the public against securities frauds. The name is believed to have originated when a judge ruled that a particular stock had about the same value as a patch of blue sky.

**Brownian Motion** - a **stochastic** process that has stationary independent increments which follows a normal distribution and also has continuous sample paths. It is a **Markovian process**, and is also known as a Wiener process.

**Bond** Securitized debt.

**BTU** - an acronym for **British Thermal Unit**.

**Call Option** - option that gives the buyer the right, but not the obligation, to buy a futures contract for a specified price within a specified period of time in exchange for a one-time premium payment. See also **Put Option**.

**Call Spread** - an option trading strategy involving buying a call option with a certain strike price and selling a call option having the same expiration date as the first but at a different strike price.

**Capacity Factor** - the amount of energy that a power generation plant actually generates compared to its maximum rated output, expressed as a percentage.

**Cash Flow Hedges** - in U.S. accounting terminology, a hedge of a forecasted asset and liability acquisition, for which the gain or loss on the hedging instrument will remain in equity when the asset or liability is acquired. That gain or loss will subsequently be included in net profit or loss in the same period as the asset or liability affects net profit or loss.

**CBOT** - an acronym for the Chicago Board of Trade.

**CFTC** - an acronym for the U.S. Commodities Futures Trading Commission.

**Chi-Squared Distribution** - the distribution for the square of a normal random variable. The chi-squared distribution arises frequently in applications because of its close association with the **normal distribution**.

**CHP** - an acronym for Combined Heat and Power. A term referring to cogeneration, more commonly used in Europe and other non-U.S. countries.

**CME** - an acronym for the Chicago Mercantile Exchange.

**Coefficient of Determination** - a measure of the proportion of variance in *y* which can be explained by *x*.

**Cogeneration** - the production of electricity and useful thermal energy from a common fuel source.

**Collateral Assets** held to secure an obligation.

**Collateralized Debt Obligation** A securitized interest in debt.

**Combined Cycle** - two or more generation processes in series or in parallel, configured to optimize the energy output of the system. For electric power, the combination of a gas turbine and a steam turbine in an electric generation plant. The waste heat from the gas turbine provides the heat energy for the steam turbine.

**Confidence Interval** - a confidence interval for a parameter is a random interval constructed from data in such a way that the probability that the interval contains the true value of the parameter can be specified before the data are collected.

**Contango** - market situation in which prices in succeeding delivery months are progressively higher than in the nearest delivery month; the opposite of backwardation. See also **Backwardation**.

**Continuous Variable** - a quantitative variable is continuous if its set of possible values is uncountable. Examples include temperature, exact height, exact age (including parts of a second). Since in practice one can never measure a continuous variable to infinite precision, continuous variables are sometimes approximated by discrete variables.

**Convexity** - a measure of the sensitivity of duration to changes in yield levels. Convexity is a measure of the stability or instability of the measured duration over a range of yields. If convexity is low, that is, if the price/yield relationship is close to a straight line, duration is stable. If convexity is high, duration is unstable. The greater an instrument’s convexity, the less accurate duration will be

**Cooling Degree Day** - a typical index variable in **weather derivative** transactions. Also referred to as CDD.

**Correlation** - a measure of linear association between two (ordered) lists. Two variables can be strongly correlated without having any causal relationship, and two variables can have a causal relationship and yet be uncorrelated. In a two-dimensional plot, the degree of correlation between the values on the two axes can be quantified by the so-called correlation coefficient (see below). Correlation can be an important consideration in risk management for such areas as developing surrogate hedges, structuring hybrid instruments, and demonstrating hedge effectiveness within accounting & reporting rules of **FAS 133**.

**Correlation Coefficient** - the correlation coefficient (also referred to as "**r**") provides an index of the degree to which variables co-vary in a linear fashion.

**Counter Party Risk** - the risk that a counter party to a transaction or contract will default (fail to perform) on its obligation under the contract. Counter party risk is not limited to credit risk (the risk that the counter party cannot fulfill its contractual obligations for payment) but may also result from other problems associated with a counterparty unwilling to honor the contract.

**Covariance** - a measurement of the relationship between two variables. The **arithmetic mean** of the products of the deviations of corresponding values of two quantitative variables from their respective means.

**Covariance Matrix** - a square, symmetrical matrix in which the rows and columns are variables, and the entries are covariances. The diagonal elements (the covariance between a variable and itself) will equal the **variances**.

**Coverage Ratio** - the ratio of earnings to some key expense, such as interest or dividend payout.

**Cox-Ross-Rubinstein Option Pricing Model** - an option pricing model (CRR) developed by John Cox, Stephen Ross, and Mark Rubinstein that can be adapted to include effects not included in the **Black-Scholes Model** (e.g., early exercise).

**Credit Risk** Risk due to uncertainty in a counterparty's ability to perform on an obligation.

**Convexity Bias** A bias in Eurodollar futures rates that makes them slightly higher than corresponding forward rates.

**Corporate Bond** A bond issued by a corporation.

**Currency Swap** A swap for the exchange of cash flow streams in two different currencies.

**Crack Spread** - a commodity-product spread involving the purchase of crude oil futures and the sale of gasoline and heating oil futures.

**Credit Default Swap** - a bilateral over-the-counter (OTC) contract in which the seller agrees to make a payment to the buyer in the event of a specified credit event in exchange for a fixed payment or series of fixed payments; the most common type of credit derivative; also called Credit Swap.

**Credit Derivative** - a derivative product with a payoff that depends on risk factors related to credit quality, such as yield spread over Treasuries, price discount from par, or a "credit event" such as a drop in credit rating or some sort of failure, such as occurrence of default, insolvency or bankruptcy.

**Credit Enhancement** Any methodology that reduces the credit risk of a transaction with counterparty.

**Credit Risk** - the risk that a counter party to a transaction or contract does not perform, including repayment on debt obligations but also payments on commercial transactions such as hedges and derivatives.

**Credit Scoring** - a system used by lenders to calculate the statistical probability of repayment on possible loans or extensions of credit.

**Critical Day Option** - an option structure used for **weather derivative** transactions where the option payoff is based on defined critical conditions being met for a specified number of days.

**CSI**: Derivatives Connect Systems Inventory is a repository of Derivatives Connect internally developed application software. This application is accessible via the [Mystic Portal](#MYSTIC).

Product Owner: The technology product owner or manager, as defined in CSI, is directly responsible for the development and maintenance of the application.

**Cumulative Probability Distribution Function** - the cumulative distribution function of a random variable is the chance that the random variable is less than or equal to *x*, as a function of *x*.

**Currency Risk** - the financial risk posed by fluctuating worldwide exchange rates.

**Current Ratio** - refers to the ratio computed as the current assets divided by current liabilities from the most recent quarter. The current ratio is a measure of a firm's immediate financial health and its ability to meet current obligations.

**Curvilinear Function** - a function whose value, when plotted, will follow a continuous but not necessarily straight line, such as a polynomial, logistic, exponential, or sinusoidal curve.

**DAX** - a benchmark index tracking 30 blue chip stocks traded on the Frankfurt Stock Exchange.

**Dashboard** - in risk management, trading and financial applications, a consolidated report and/or graphical display highlighting key financial results and control metrics, such as current and trending level of **VaR**, current trading positions against established limits, and daily **Mark-to-Market** gains and losses.

**Default Probability** - the likelihood that a transaction counter party will default on an obligation.

**Degree Day** - a typical index variable in **weather derivative** transactions. Degree Days are a practical method for determining cumulative temperatures over the course of a season. Originally designed to evaluate energy demand and consumption, degree days are based on how far the average temperature departs from a human comfort level of 65 degrees Fahrenheit. See also Cooling Degree Day and Heating Degree Day.

**Delta** - sensitivity of an option's value to a change in the price of the underlying futures contract, also referred to as an option's futures-equivalent position. Deltas are positive for calls, and negative for puts. Deltas of deep in-the-money options are approximately equal to one; deltas of at-the-money options are 0.5; and deltas of deep out-of-the-money options approach zero.

**Delta Hedging** - a hedging strategy that uses futures contracts to hedge options and involves re-balancing an option portfolio periodically to maintain a specific delta (e.g. a delta of zero).

**Delta Neutral** - refers to a position or portfolio involving **options** that is designed to have an overall delta of zero.

**Denatured** - ethanol that has had a substance added to make it unfit for human consumption.

**Derivative Instrument** An instrument that derives value from the value of some commodity, energy, or other financial instrument.

**Derivative Instrument** - an instrument which derives value from the value of some commodity or other financial instrument. Often referred to simply as **Derivatives**. Various authorities define derivative instruments in broad, inclusive terms or narrow, exclusive terms. For U.S. accounting rules in **FAS 133**, the FASB defines derivatives narrowly.

**Designated Hedges** - in U.S. accounting terminology under **FAS 133**, a derivative transaction that has been specified and contemporaneously documented as intended to hedge the financial risks of an asset or liability position, a firm commitment, or a foreign currency position or forecasted transaction.

**Differential Swap** - a **Quanto swap**.

**DIG** - an acronym for the **FASB**'s Derivatives Implementation Group, which is a task force that was created by the FASB in 1998 concurrent with their issuance of FASB Statement No. **133**, *Accounting for Derivative Instruments and Hedging Activities*, to assist the FASB in providing guidance on questions that companies would face when they began implementing FAS 133.

**Digital Option** - a **Binary Option**.

**Dispersion** - the distribution pattern of measurements. The **Standard Deviation** is the most common measure of dispersion.

**Dividend Yield** - a stock's dividend expressed as a percentage of the share price.

**Drexel Burnham Lambert** - the now defunct investment bank that dominated the **junk bond** market of the 1980's.

**Duration** - a sophisticated measure of the average timing of cash flows from an asset or a liability or from an asset portfolio or a liability portfolio. Essentially, duration is a more accurate measure of maturity because it reflects the timing of cash flows from periodic interest and/or principal payments in addition to the cash flows represented by the funds transferred at maturity. Duration is computed by summing the present values of all of the future cash flows after multiplying each by the time until receipt, and then dividing that product by the sum of the present value of the future cash flows without weighting them for the time of receipt. See also **Convexity**.

**Duration-Convexity Matching** - a technique of asset-liability matching.

**Efficient Frontier** - a theoretical set of portfolios offering optimal risk-reward tradeoffs.

**EDGAR** - is a federally registered trademark of the U.S. Securities and Exchange Commission (**SEC**) and is the acronym for Electronic Data Gathering, Analysis, and Retrieval. EDGAR is the SEC's system used by all public companies to transmit required filings, such as quarterly reports and annual reports and ongoing disclosure obligations. EDGAR filings can be accessed online directly from the SEC or through various online service companies.

**EFP** - an acronym for Exchange for Physicals; an alternative to physical settlement offered by many futures exchanges.

**EITF** - an acronym for the Emerging Issues Task Force, a unit of the Financial Accounting Foundation that addresses accounting issues not yet addressed by a published **FASB** Statement of Financial Accounting Standards.

**Embedded Derivatives** - within a U.S. accounting context of FAS 133, portions of contracts that meet the definition of a **derivative** when the entire nonderivative contract cannot be considered a financial instruments derivative. See also **FAS 133** and **PIPES** (Private Investments in Public Equities).

**Emissions Credits** - the instruments created by regulations in the U.S. market to encourage market-driven reductions of pollution.

**Equity Default Swap** A far out-of-the-money equity option structured much like a credit default swap.

**European Option** - an option that can only be exercised on its expiration date. See also **American Option**.

**Eurodollar Future** A cash-settled future on a 3-month Eurodollar deposit.

**Exchange for Physicals (EFP)** - a transaction in which the buyer of a cash commodity transfers to the seller a corresponding amount of long **futures** contracts, or receives from the seller a corresponding amount of short futures, at a price difference mutually agreed upon. In this way, the opposite hedges in futures of both parties are closed out simultaneously.

**Exchange Traded** - traded on a regulated exchange such as the **New York Stock Exchange**, **Chicago Board of Trade**, or **New York Mercantile Exchange**.

**Exercise Price (Strike Price)** - the price, specified in the option contract, at which the underlying futures contract, security, or commodity will move from seller to buyer.

**Extendable Option** - an option whose expiration may be extended.

**Extrapolation** - estimation of the value of a variable for future times at which the value has not yet been observed. This estimate may be reasonably reliable for short times into the future, but for longer time periods the estimate may become less accurate.

**Extrinsic Value** - the time value of an option, which reflects the probability that the option may move into the money before expiration.

**Fair Value** - in the pricing of financial instruments, the value determined by mathematical modeling of the instruments value. Also used as a defined term in U.S. accounting standards as fair value accounting and 'fair value hedges' as in FASB Statement FAS 133. A Fair Value Hedge is a hedge of the exposure to changes in the fair value of a recognized asset or liability, or of an unrecognized firm commitment, which are attributable to a particular risk.

**Fallen Angel** - a bond that was investment grade when issued, but has since degraded to junk quality.

**Firm Liquidated Damages** - a contract that requires firm [certain] delivery of the specified commodity, or the payment of its equivalent financial value as damages for failure to perform.

**Firm Power** - electric power which is guaranteed by the supplier to be available at all times during a period covered by a commitment. That portion of a customer's energy load for which service is assured by the utility provider.

**Floor** - a type of derivative instrument that offers protection against declining prices, exchange rates or interest rates.

**Financial Engineering** - the field of applied finance devoted to the design and pricing of derivative instruments and structured products.

**Fixed Income Term Structure** Refers collectively to a spot curve, forward curve, discount curve, yield curve or any other curve that describes the time value of money.

**Floater** A fixed income instrument whose coupon fluctuates with some designated reference rate.

**Foreign Currency Hedges** - transactions entered into in order to eliminate or mitigate the financial risks of exposures to fluctuations in foreign exchange rates. In U.S. accounting terminology, derivative transactions meeting the criteria specified in Financial Accounting Standard 133. A detailed analysis of **FAS 133 reporting for a foreign currency hedge transaction** is available here. See also FAS 133 above.

**Forward Rate Agreement** A cash-settled forward contract on a short-term loan.

**Functional Currency** - as terminology in U.S. accounting standards, the primary currency in which an entity conducts its operation and generates and expends cash.

**Futures Contract** - a transaction on a regulated futures exchange, such at the **NYMEX** or **CBOT**.

**Gamma** - the sensitivity of an option's **delta** to changes in the price of the underlying futures contract.

**Greeks** - a set of factor sensitivities used for measuring risk exposures related to options or other derivatives. The key Greek measures are: **delta**, **gamma**, **rho**, **theta**, and **vega**.

**Green Book** - a compendium of information on **FAS 133**, or other statements and materials related to FAS 133, prepared by the Financial Accounting Standards Board (**FASB**), which encompasses about 800 pages.

**Group of 30 Report** - an influential 1993 industry report on OTC derivatives. Also referred to as the G-30 Report.

**Hedge** - a transaction or position taken in order to eliminate or mitigate the risk of adverse price movements in an exposure position such as an existing asset or liability position.

**Hedge Accounting** - accounting methodology established by provisions of FAS 133 for reporting of gains and losses on transactions intended to hedge exposed positions. Various criteria must be met as specified in **FAS 133** in order to use hedge accounting for U.S. financial reporting. See also **FAS 133**.

**Hedge Effectiveness** - in U.S. accounting terminology, a criteria that must be met in order to use Hedge Accounting for U.S. financial reporting. This provision has proven problematic in the energy industry where partial hedges for such exposure components as **basis risk** are widely used. Under the rules of FAS 133 when testing for hedge effectiveness, only interest rate exposures can be broken down into their component parts. See also **FAS 133**.

**Henry Hub** - a natural gas pipeline hub in Louisiana that serves as the delivery point for **New York Mercantile Exchange** natural gas futures contracts and often serves as a benchmark for wholesale natural gas prices across the U.S.

**Herstatt Risk** - settlement risk; named after the German bank, Herstatt, whose 1974 failure highlighted the dangers of settlement risk.

**High Grade** - a phrase used to describe investments with the highest quality ratings — usually AAA or AA.

**Historical Volatility** - the annualized **Standard Deviation** of percent changes in prices over a specific period. It is an indication of past volatility in market prices. See also **Implied Volatility**.

**Holding Period** - a time period over which the variability in the value of a portfolio of assets or potential earnings from some economic activity is assessed. See also VaR.

**Implied Volatility** - a volatility level inferred from an option price. See also **Historical Volatility**.

**In-The-Money** - a term used to describe an option contract that has a positive value if exercised.

**Interest Rate Parity** - an **arbitrage** condition that must hold between the spot interest rates of different currencies.

**International Accounting Standards Committee (IASC)** - an organization headquartered in London that has been charged with developing international accounting standards.

**Interpolation** - for a given a set of bivariate data (x,y), imputing a value of y corresponding to some value of x at which there is no measurement of y, where the value of x is within the range of the measured values of x. See also, Extrapolation.

**Interest Rate Caps** A derivative instrument which is linked to interest rates.

**Interest Rate Parity** An arbitrage condition that must hold between the spot interest rates of different currencies.

**Interest Rate Spreads** Spreads between interest rates.

**Interest Rate Swap** A swap under which both cash flow streams are in the same currency and are defined as cash flow streams that might be associated with some fixed income obligations.

**International Bond** Any bond issued or invested in across national boarders.

**Intrinsic Value** - the amount by which an option is in-the-money. An option which is not in-the-money has no intrinsic value. For calls, intrinsic value equals the difference between the underlying futures price and the option's strike price. For puts, intrinsic value equals the option's strike price minus the underlying futures price. Intrinsic value is never less than zero.

**Inverse Floater** - a floater whose coupon varies inversely to its reference rate.

**ISDA** - the International Swaps and Derivatives Association.

**January Effect** - the tendency for small capitalization stocks to exhibit an upward bias in their price behavior during the month of January. Some observers believe this may be partially attributable to the influence of index funds buying stocks for various retirement plans when new contributions would be qualified to commence in January.

**Jensen Index** - an index that uses the capital asset pricing model to determine whether a money manager outperformed a market index.

**Joint Normal Distribution** - a multivariate distribution with normal marginal distributions.

**Jump-Diffusion Model** - a **stochastic** process that combines random jumps with a geometric **Brownian motion**.

**Junk Bond** - a bond whose credit rating is below BBB.

**Kappa** - a value representing the expected change in the price of an option. Also known as Lambda.

**Kholodnyi Model** - a valuation model developed by the mathematician Valery A. **Kholodnyi** for use in valuing and hedging electric power price risks in environments of extreme price spikes.

**Knock-in Option** - an option feature which triggers the activation of an option contract. Also referred to as Down-and-In and Up-and-In, depending on the structure.

**Knockout Option** - an option that becomes worthless in the event that the underlying commodity or currency crosses a certain price level.

**LIBOR** - the London Interbank Offered Rate. The rate of interest at which banks borrow funds from other banks, in marketable size, in the London interbank market.

**Linear Instruments** - financial instruments whose value varies in a linear fashion with underlying market price changes. This includes financial instruments such as **futures** and plain vanilla **swaps**.

**Liquidity** - a market condition in which assets or products can be traded with ease without dramatically altering their current quoted prices. A market is said to be "liquid" when it has a high level of trading activity and open interest.

**LME** - an acroynm for the **London Metal Exchange**.

**Long Position** - the state of actually owning a security, contract, or commodity; in trading and risk management jargon also referred to as a 'long'. Opposite of a short.

**Lookback Option** - an exotic option whose payoff depends on the minimum or maximum price of the underlying asset during some portion of the life of the option.

**Mark-to-Market (MTM)** - the act of assigning a current market value to an asset.

**Market Cap or Market Capitalization** - a value placed on a shareholder-owned company. It is computed by multiplying the number of outstanding shares by the current share price.

**Market Risk** - the potential to experience financial losses due to fluctuations in the prices at which equities, foreign currencies, interest rate linked securities, and commodities can be bought or sold.

**Markov Process** - a **stochastic** process where the future expected value of a value (such as an asset price) is dependent only on the current value. Named after the Russian mathematician Andrey Andreyevich Markov (1856-1922).

**Material Adverse Change (MAC)** - generally any negative event that would be considered material by creditors. MAC clauses are often used as contract provisions that trigger defined changes, rights or actions.

**Mean** - is often considered as the simple arithmetic average of the sum of the observed values divided by the number of observations. It is customary to represent the Mean by *μ*.

**Mean Reversion** - a tendency for a **stochastic** process to remain near, or return over time to a long-run average.

**Model Risk** - the risk of financial loss due to weakness or inaccuracy of a financial model used for valuing assets or portfolios of assets and/or managing risk.

**Monte Carlo** - an analytical technique in which a large number of simulations are run using random quantities for uncertain variables and using the distribution of results to infer which values are most likely. The name comes from the Monte Carlo section of the city-state of Monaco, which is known for its casinos and gambling.

**Monte Carlo Simulation** - as referred to above, in which the simulation randomly generates values for uncertain variables over-and-over in order to simulate an outcome.

**Naked Calls** - an option strategy for which the investor sells a call against securities, commodities or other positions that the investor does not own.

**NASDAQ** - the acronym for the National Association of Securities Dealers Automated Quotations or Quote system that links brokers and dealers in an unified price quotation system.

**Net Settlement** - a contract provision that allows for netting out payables and receivables in terms of cash or items that can be readily converted to cash in an established market.

**Negative Carry** - the condition whereby a portfolio after financing considerations generates a negative income stream or loss.

**Non-attainment Area** - a U.S. geographic area in which air quality is worse than that allowed by the U.S. federal air pollution standards.

**Normal Distribution** - a continuous probability distribution whose probability density function has a "bell" shape. A normal distribution is symmetric, and has zero **skewness**. A normal distribution is fully described with two parameters, its **mean** and **standard deviation**.

**Notional** - the face amount of a transaction; typically used as the basis for interest payment calculations or determination of other payment amounts. This face or prinicipal amount is referred to as 'notional' since it is not typically an amount that is paid or received.

**Option** - a contract that gives the right, but not the obligation, to purchase or sale an **underlying** asset at a specified price during a defined time period.

**Option Premium** - the amount that an option buyer pays to the seller.

**Open Interest** - the total number of **futures** contracts or option contracts that have not yet been exercised, expired, or fulfilled by delivery.

**Operational Risk** - the risk to financial or other institutions from inadequate or failed internal processes, people and systems or from external events.

**Out of the Money** - for call options, the condition where the price of the underlying asset is less than the exercise or strike price of the option. Conversely, for put options, the condition where the price of the underlying asset is higher than the strike price of the option.

**Over The Counter (OTC)** - traded in some context other than a formal exchange.

**Par** - the stated face amount assigned to a security by the issuer.

**Parametric** - a term used to classify curves for which the path is described by a mathematical function rather than a set of coordinates.

**Parametric VaR** - linear **Value at Risk**.

**Path Dependent Option** - an option whose valuation and payoff depends on the realized price path of the underlying asset, such as an **Asian option** or a **Lookback option**.

**Payoff Diagram** - a graph of a transaction's payoff as a function of underlier value at expiration.

**P/E Ratio** - the latest closing price of a stock divided by the latest 12 months' earnings per share. Also known as the P/E Multiple.

**Put-Call Parity** - a relationship between the prices of European put and call options on the same underlier.

**Put Option** - an option which gives the option buyer the right, but not the obligation, to sell a futures contract at a specific price within a specific period of time in exchange for a one-time premium payment. See also **Call Option**.

**Quadratic Portfolio** - in the context of Value-at-Risk, a portfolio whose portfolio mapping function is a quadratic polynomial.

**Quadratic Programming** - a variant of linear programming whereby the objective function is quadratic rather than linear. For example, in portfolio selection, the variance of the portfolio (which is a quadratic function) may be minimized subject to constraints on the mean return of the portfolio.

**Quality Spread** - the spread between Treasury securities and non-Treasury securities that are identical in all respects except for quality rating. For example, the difference between yields on Treasuries and the yields on single A-rated industrial bonds. Also referred to as the credit spread.

**Quantile** - a notion from probability. Generally, the specific value of a variable that divides the distribution into two parts, those values greater than the quantile value and those values that are less. For instance, p percent of the values are less than the pth quantile.

**Quanto Option** - an option in one currency, but which pays out in another. These currency options have a guaranteed exchange rate that enable buyers who like the underlying asset, German bonds for example, but not the assets pricing currency, to arrange to be paid in a different currency for a fee.

**Quanto Swap** - an interest rate swap in one currency, but which pays out in another based on a fixed exchange rate.

**Quick Asset Ratio** - refers to the ratio of cash, cash equivalents and accounts receivable relative to the total current liabilities. Also known as the Acid Test Ratio. This measure of liquidity is more rigorous than the **Current Ratio**.

**Range Forward** - a type of derivative instrument. A forward exchange rate contract that places upper and lower bounds on the cost of foreign exchange.

**Rank Tests** - nonparametric tests that are calculated by replacing the data by their rank values.

**Ratio Spread** - an options strategy using either puts or calls, in which one buys options and then sells a different amount of options.

**Rho** - the interest rate sensitivity of an option relative to a change in the interest rate option pricing variable. It measures an option's change in value for a given change in the interest rate.

**Risk Adjusted Return** - a measure of abnormal rate of return that shows how an asset performed relative to a benchmark asset with the same risk. Determined by subtracting from the rate of return on an asset a rate of return from another asset that has imilar risk. The **Beta** against the benchmark can be used to calculate an **Alpha** which is also risk adjusted preformance.

**Rollover** - transfer of a position to a different delivery month.

**SEC** - an acronym for the United States Securities and Exchange Commission.

**Settlement Price** - the closing range of prices after a trading session, used to calculate gains and losses, margin calls, and invoice prices for deliveries in futures market accounts.

**Straddle** - an option trading strategy using a combination of a put and a call with the same epiration date and same strike price. This strategy is based on an expectation that the price volatility level of the underlying asset will increase and generate a potential trading profit on the options position.

**Stress Test** - a test of a model for pricing or risk management, using an extreme scenario or range of scenarios.

**Structured Note** - a derivative instrument whose value is based on that of an underlying index.

**Swap** - a contract between two counter parties to exchange future cash flows in accordance with a specified formula for exchange.

**Swaption** - an option to enter into a swap—i.e., the right, but not the obligation, to enter into a specified type of swap at a specified future date.

**Swing Options** - an option contract that provides a volume range, rather than a fixed quantity, for the specified underlying. Swing options have wide application in commodity markets since these options can provide an effective match to underlying exposures where there is uncertainty as to quantity (**volumetric risk**), however, valuing and trading such options is highly complex quantitatively.

**SWOT Analysis** - an analysis of Strengths, Weaknesses, Opportunities and Threats. This methodology is widely used in strategic assessments and planning.

**Systemic Risk** - the risk that the entire financial system collapses due to some catastrophic market event triggering the failure.

**Tenor** - the time remaining to maturity for a financial instrument, transaction, asset or liability, or a portfolio of these items.

**Theta** - sensitivity of an option's value to a change in the amount of time remaining until expiration.

**Time Decay** - the tendency of an **option** to decline in value as the expiration date approaches, especially if the price of the **underlying** instrument is exhibiting low volatility.

**Total Return Swap** - a type of **credit derivative**.

**Treasury Security** US Federal Government debt obligation issued by the Department of Treasury.

**Underlying** - in an **option** contract, the security or commodity that is delivered when the contract is exercised.

**URL**: The address of a web page on the World Wide Web; an Internet address (for example, http://www.hmco.com/trade/), usually consisting of the access protocol (http), the domain name (www.hmco.com), and optionally the path to a file or resource residing on that server (trade); uniform resource locator, universal resource locator.

**Value at Risk (VaR)** - a quantitative methodology for estimating market risk. A more detailed description of VaR can be displayed from the Risk Limited Factoids page **here**.

**Variance** - a measure of volatility, risk, or statistical dispersion. It is the square of the **standard deviation**.

**Variance-Covariance VaR** - linear VaR.

**Vega** - the measure of change in an **option** value given a change in the volatility.

**Venn Diagram** - a pictorial depiction of the relations among sets or events, where set are shown as regions with the overlap of the regions corresponds to the intersection of the sets. If the regions do not overlap, the sets are disjoint.

**Volatility** - a measurement of the rate of price change of a futures contract, security, or other instrument underlying an option. See also **Historical Volatility**, **Implied Volatility**.

**Volatility Smile** - a condition where implied volatilities for in-the-money and out-of-the-money strikes exceed those for at-the money strikes. Graphically depiction of this condition is a curve in the form of a 'smile', hence the name.

**Volumetric Risk** - risk resulting from uncertainty and changes in exposure level for usage, productions or other factors. Hedge instruments structured to manage such risks include **Swing Options**.

**Wasting Asset** - a **derivative instrument** that may expire worthless after a stated time or event. Options, Rights, and Warrants are examples.

**Yield** - the annual return on an investment, typically expressed as a percentage.

**Yield Curve Option-Pricing Models** - models that can incorporate different volatility assumptions along the yield curve, such as the **Black-Derman-Toy** model. Also called arbitrage-free option-pricing models.

**Yield Curve** - a graphic representation of market yield for a fixed income security plotted against the maturity of the security.

**Yield Curve Strategies** - positioning a portfolio to capitalize on expected changes in the shape of the yield curve.

**Yield to Maturity** - the percentage rate of return paid on a bond, note or other fixed income security which is bought and held to its maturity date. The calculation for the yield to maturity is based on the coupon rate, length of time to maturity, and market price. The calculation assumes that coupon interest paid over the life of the bond will be reinvested at the same rate, which is a simplifying assumption that may at times differ significantly from actual conditions.