Interest Rate Instruments and Market Conventions Guide

OpenGamma Quantitative Research

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Contents

Preface

This booklet is about finance and more precisely about interest rate derivatives. Nevertheless, it contains no models, no numerical methods and nothing new. It contains what everybody is supposed to know when they first start working in the industry: the habits, standards, conventions and all unsaid details regarding those instruments. Everybody is supposed to know about them but, to our knowledge and despair, they are not available in one unique, easily accessible document.

In our experience, as Risk Managers, Quantitative Analysts, Back-Office Officers or Traders, we have all one day or another looked for a small detail about a very familiar instrument without finding it. Is Euribor using the end-of-month rule? What is the standard payment frequency for three years AUD swap? What is the last trading date of a mid-curve option on Liffe? Those questions may sound familiar. The only way to find an answer is to ask your colleagues, search on the internet or call a counterpart; at least up to now. The goal of this booklet is to make all those details available in a single document.

Nowhere in this document we discuss pricing or valuation mechanisms, even for the simplest instruments. The link to valuation is that any valuation technique for any instrument presented should include all the relevant instrument features. Most of the standard books and articles smooth the roughness of real life. Day count and business day conventions are supposed to appear magically, when they are mentioned at all. We all know that nothing appears magically and that there is no such thing as a *free lunch*. We do not offer you any of those free lunches, but hopefully we can help you find the salt and pepper for your own lunch.

The goal of this document is to present *conventions* and *market standards* for the most common financial instruments. Those market standards are relative, and they evolve. We have done our best to collect the information and check it. For the same instrument, two groups of people may have different conventions. This is the case for example with USD swaps: some use an annual money market basis on the fixed leg and others semi-annual bond basis. The conventions evolve; this is the case for example for swaptions for which the standard changed from an up-front premium to a forward premium in September 2010.

The document is certainly not intended to be read from start to end like fiction. If quantitative finance is compared to a novel, this booklet would be the introduction of the main characters. It is a reference document and we expect the reader to read at most one chapter at a time, and more often one section or even one line. A relatively extensive index has been provided to help you find the right sections. This is also the way it was written, adding lines, currencies, and instruments when they were required in our developments.

The chapters have been divided in three parts. The first one is called *References*. It describes the financial associations that set most of the standards and the main exchanges for interest rate derivatives. It also contains the definitions of the day count and business day conventions. It finishes with the details on the main overnight and Ibor-like indexes.

The second part is called *Exchange-traded instruments* and describe the instruments listed on exchanges, such as interest rate futures, bond futures and their options.

The third and last part is called *Over-the-counter instruments* and describes the most liquid instruments of the interbank market instruments. In particular it contains different swaps (IRS, OIS, basis swaps, etc.) and different options (swaptions, caps/floors, CMS, etc.). The market being OTC, there is obviously more room for customization in the rules and conventions applied to any particular deal. We have tried to describe the most frequent one.

Obviously this document is not perfect and we plan to add, complement, or correct when necessary. Do not hesitate to suggest corrections and additions.

The devil is in the details.

[1] As this is an open license, we can not incorporate restricted information. In particular Reuters codes, which are restricted to customers with a commercial relation with Reuters, are not provided.

Part 1

References

CHAPTER 1

Associations

Many rules and standards are proposed or collected by financial associations. The main ones are described in this chapter.

1. International Swaps and Derivatives Association

The International Swaps and Derivatives Association (ISDA) was founded in 1985.
In particular the association publishes the *ISDA Definitions*.
Reference: http://www2.isda.org/

2. British Bankers' Associations

The British Bankers' Association (BBA) is the trade association for the UK banking and financial services sector.
Reference: http://www.bba.org.uk/

3. Euribor-EBF

Euribor-EBF is an international non-profit association founded in 1999 with the launch of the Euro. Its members are national banking associations in the Member States of the European Union which are involved in the Eurozone and the Euro-system.
Reference: http://www.euribor-ebf.eu/

4. Australian Financial Markets Association

The Australian Financial Markets Association (AFMA) was formed in 1986.
Reference: http://www.afma.com.au/

5. Danish Bankers Association

The Danish Bankers Association is an organisation representing the banks in Denmark. It has the overall responsibility for CIBOR indexes.
Reference: http://www.finansraadet.dk.

6. Wholesale Markets Brokers Association

The Wholesale Markets Brokers Association (WMBA) is the associate of London brokers.
Reference: http://www.wmba.org.uk/.

7. Japanese Bankers Association

The Japanese Bankers Association is a financial organization whose members consist of banks, bank holding companies and bankers associations in Japan.
Reference: http://www.zenginkyo.or.jp/en/

CHAPTER 2

Exchanges

There are many exchanges where financial instruments are traded throughout the world. We have included the main ones where interest rate derivatives are listed. Over the years, a lot of mergers and acquisitions took place between the different exchanges. The names and organizational structures have changed and will certainly change again.

1. CME Group

The CME group is a result of mergers between the Chicago Mercantile Exchange (CME), the Chicago Board of Trade (CBOT), New York Mercantile Exchange (NYMEX) and COMEX.

In the interest rate landscape, the main products are the interest rate futures (on Libor) and their options listed on CME, the federal funds futures listed on CBOT and the bond futures and their options listed on CBOT.
Reference: www.cmegroup.com

2. NYSE Euronext

Result of mergers/acquisitions between Euronext, New York Stock Exchange (NYSE), Liffe and Amex.

In the interest rate landscape, the main products are the interest rate futures (on LIBOR and EURIBOR) and their options listed on Liffe.
Reference: http://www.euronext.com/

3. Eurex

Eurex is a derivatives exchange jointly operated by Deutsche Börse AG and SIX Swiss Exchange. It started its derivative trading in 1998.

In the interest rate landscape, the main products are the interest rate futures (on EURIBOR) and their options and the EUR bond futures.
Reference: http://www.eurexchange.com/index.html

4. Tokyo Stock Exchange

In the interest rate landscape, the main products are JPY bond futures.
Reference: http://www.tse.or.jp/english/

5. Australian Securities Exchange

In the interest rate landscape, the main products are the AUD bank bill futures and their options and AUD bond futures.
Reference: http://www.asx.com.au/

6. Singapore Exchange

In the interest rate landscape, the main products are Japanese government bond futures, JPY Libor and Tibor futures/options and the Eurodollar futures/options.
Reference: http://www.sgx.com/

7. NASDAQ OMX

In the interest rate landscape, the main products are Nordic futures: CIBOR futures, STIBOR futures and Swedish bond futures. They are also known for publishing the CIBOR rates.
Reference: http://www.nasdaqomx.com/

CHAPTER 3

Day count conventions

1. 30/360 methods

The *30/360 methods* group a certain number of methods that have in common to compute the accrual factor as

$$\frac{360(Y_2 - Y_1) + 30(M_2 - M_1) + (D_2 - D_1)}{360}$$

but differs on how the Y_i, M_i and D_i are computed.

2. 30/360 US

The date adjustment rules are the following (more than one may take effect; apply them in order, and if a date is changed in one rule the changed value is used in the following rules):

- If D2 is 31 and D1 is 30 or 31, then change D2 to 30.
- If D1 is 31, then change D1 to 30.

This day count convention is also called *Bond basis*.

3. 30E/360

The date adjustment rules are the following:

- If D1 is 31, then change D1 to 30.
- If D2 is 31, then change D2 to 30.

4. ACT/360

This day count is also called *Money Market basis* or Actual 360. The accrual factor is

$$\frac{d_2 - d_1}{360}$$

where $d_2 - d_1$ is the number of days between the two dates.

This is the most used day count convention for money market instruments (maturity below one year).

5. ACT/365 Fixed

Also called *English Money Market basis*. The accrual factor is

$$\frac{d_2 - d_1}{365}$$

where $d_2 - d_1$ is the number of days between the two dates. The number 365 is used even in a leap year.

6. ACT/ACT ISDA

The accrual factor is

$$\frac{\text{Days in a non-leap year}}{365} + \frac{\text{Days in a leap year}}{366}.$$

To compute the number of days, the period first day is included and the last day is excluded.

Examples:

- Start date 30-Dec-2010 / End date: 2-Jan-2011: 3/365 = 0.008219...
- Start date 30-Dec-2011 / End date: 2-Jan-2012: 2/365 + 1/366 = 0.8211...
- Start date 30-Dec-2010 / End date: 2-Jan-2013: 367/365 + 366/366 + 1/365 = 3/365 + 2 = 2.008219...

7. Business/252

This day count is also called *BUS/252*. This day count is based on the business, not calendar days. The accrual factor is

$$\frac{\text{Business days}}{252}$$

where the numerator is the number of business days (in a given calendar) from and including the start date up to and excluding the end date.

CHAPTER 4

Business day conventions

A *business day convention* is a convention for adjustment of dates when a specified date is not a good business day. The adjustment is done with respect to a specific calendar.

1. Following

The adjusted date is the following good business day.
Examples:

- Start date 18-Aug-2011, period 1 month: end date: 19-Sep-2011.

2. Preceding

The adjusted date is the preceding good business day.
This convention is often linked to loans and it is a translation of the amount that should be paid *on or before* a specific date.
Examples:

- Start date 18-Aug-2011, period 1 month: end date: 16-Sep-2011.

3. Modified following

The adjusted date is the following good business day unless the day is in the next calendar month, in which case the adjusted date is the preceding good business day.
This is the most used convention for interest rate derivatives.
Examples:

- Start date 30-Jun-2011, period 1 month: end date: 29-Jul-2011. The following rule would lead to 1-Aug which is in the next calendar month with respect to 30-Jul.

4. Modified following bimonthly

The adjusted date is the following good business day unless that day crosses the mid-month (15th) or end of a month, in which case the adjusted date is the preceding good business day.
Examples:

- Start date 30-Jun-2011, period 1 month: end date: 29-Jul-2011. The following rule would lead to 1-Aug which is in the next calendar month with respect to 30-Jul.
- Start date 15-Sep-2011, period 1 month: end date: 14-Oct-2011. The following rule would lead to 17-Oct which crosses the mid-month.

5. End of month

Where the start date of a period is on the final business day of a particular calendar month, the end date is on the final business day of the end month (not necessarily the corresponding date in the end month).

Examples:

- Start date 28-Feb-2011, period 1 month: end date: 31-Mar-2011.
- Start date 29-Apr-2011, period 1 month: end date: 31-May-2012. 31-Apr-2011 is a saturday, so 29-Apr is the last business day of the month.
- Start date 28-Feb-2012, period 1 month: end date: 28-Mar-2012. 2012 is a leap year and the 28th is not the last business day of the month!

CHAPTER 5

Overnight indexes

Overnight indexes are indexes related to interbank lending on a one day horizon. Most indexes are for overnight loans and some for tomorrow/next loans. The rates are computed as a weighted average of actual transactions.

The most common usage of those indexes in interest rate derivatives is in overnight indexed swaps (see Chapter 17).

Some overnight indexes and their main characteristics are summarised in Table 5.1.

Currency	Name	Reference	Convention	Publication lag
USD	Fed Fund	ON	ACT/360	1
EUR	EONIA	ON	ACT/360	0
GBP	SONIA	ON	ACT/365	0
JPY	TONAR	ON	ACT/365	0
CHF	SARON	ON	ACT/360	0
CAD	CORRA	ON	ACT/365	1
AUD	RBA ON	ON	ACT/365	0
DKK	DNB TN	TN	ACT/360	0

Publication lag is the number of days between the start date of the period and the rate publication. A lag of 0 means on the start date, a lag of 1 means on the period end date.

TABLE 5.1. Overnight indexes

1. USD-Effective Federal Funds Rate

The daily effective federal funds rate is a volume-weighted average of rates on trades arranged by major brokers. The effective rate is calculated by the Federal Reserve Bank of New York using data provided by the brokers and is subject to revision. The rate is published in the morning (between 7:00 and 8:30) of the period end date. The day count convention is ACT/365.

Reference: `http://www.newyorkfed.org/markets/omo/dmm/fedfundsdata.cfm`

2. EUR-EONIA

EONIA is the acronym of *Euro OverNight Index Average*. It is computed as a weighted average of all overnight unsecured lending transactions undertaken in the interbank market, initiated within the euro area by the contributing banks (rounded to three decimal places). It is calculated by the European Central Bank. The rate is published in the evening (around 19:00 CET) of the period start date. The day count convention is ACT/360.

Reference: `http://www.euribor-ebf.eu/euribor-eonia-org/about-eonia.html`

3. GBP-SONIA

SONIA is the acronym of *Sterling OverNight Index Average*. It is the weighted average rate of all unsecured sterling overnight cash transactions brokered in London by WMBA member firms between midnight and 16:15 CET with all counterparts in a minimum deal size of GBP 25 million (rounded to four decimal places). The rate is published in the evening (around 17:00 CET) of the period start date. The day count convention is ACT/365.
Reference: http://www.bba.org.uk/policy/article/sterling-overnight-index-average-sonia-a-guide/benchmarks/

4. JPY-TONAR-Uncollateralized Overnight Call Rate

TONAR is the acronym of *Tokyo OverNight Average Rate*. It is the weighted average rate of all unsecured overnight cash transactions between financial institutions. The rate is published by the Bank of Japan (BOJ). The day count convention is ACT/365. A provisional result is publish on the evening (at 17:15 JST except on the last business day of the month where it is 18:15 JST) of the period start. The final result is published in the morning (10:00 JST) of the end date.
Reference: http://www.boj.or.jp/en/statistics/market/short/mutan/

5. CHF-SARON

SARON is the acronym of *Swiss Average Rate OverNight*. It is an overnight interest rates average referencing the Swiss Franc interbank repo market. It was launched by the Swiss National Bank (SNB) in cooperation with SIX Swiss Exchange. Since 25 August 2009, SARON has replaced the previously used repo overnight index (TOIS fixing).
Reference: http://www.snb.ch/en/ifor/finmkt/id/finmkt_repos_saron
Reference: http://www.six-swiss-exchange.com/indices/swiss_reference_rates/reference_rates_en.html

6. CAD-CORRA

CORRA is the acronym of *Canadian Overnight Repo Rate Average*. It is the weighted average rate of overnight general (non-specific) collateral repo trades that occurred through designated inter-dealer brokers between 6:00 EDT. and 16:00. on the specified date as reported to the Bank of Canada . The rate is published in the morning (9:00) of the end date. The rate is published by the Bank of Canada. The day count convention is ACT/365.
Reference: http://www.bankofcanada.ca/rates/interest-rates/money-market-yields

7. AUD-RBA Interbank Overnight Cash Rate Survey

The rate is computed by the Reserve Bank of Australia (RBA). It is a weighted average rate at which a sample of banks transact in the domestic interbank market for overnight funds. The Interbank Overnight Cash Rate calculated from the survey is published on electronic media services (Reuters RBA30/RBA36; Bloomberg RBAO9/RBAO11) at the conclusion of each trading day. The rate is published in the evening of the period start date. The day count convention is ACT/365.
Reference: http://www.rba.gov.au/mkt-operations/tech-notes/interbank-survey.html

8. DKK-Danmarks Nationalbank Tomorrow/Next interest rate

The Tomorrow/Next (T/N) money market rate interest rate is calculated and published by the Danmarks Nationalbank. The T/N interest rate is an uncollateralized day-to-day interest rate for money-market lending. The T/N interest rate is calculated as a weighted average of the interest rates on actual lending. Calculation of the T/N interest rate is based on daily reports from 11 banks. Each bank reports the uncollateralized day-to-day inter-bank lending and the average interest rate for these loans. The report is made with a time lag of one day, e.g. Monday's lending is reported on Tuesday. The day count convention is ACT/360.
Reference: http://www.nationalbanken.dk/dnuk/rates.nsf/side/reference_rates!opendocument

CHAPTER 6

Ibor-like indexes

Ibor-like indexes are indexes related to interbank lending between one day and one year. It is usually computed as the trimmed average between rates contributed by participating banks. The rates are bank's estimates but usually do not refer to actual transactions.

The most common usage of those indexes in interest rate derivatives is in swaps and caps/floors.

Some Ibor-like indexes and their main characteristics are summarized in Table 6.1.

Currency	Name	Maturities	Convention	Spot lag
USD	LIBOR	O/N--12M	ACT/360	2
EUR	EURIBOR	1W--12M	ACT/360	2
EUR	LIBOR	O/N--12M	ACT/360	2
GBP	LIBOR	O/N--12M	ACT/365	0
CHF	LIBOR	O/N--12M	ACT/360	2
JPY	LIBOR	O/N--12M	ACT/360	2
JPY	Japan TIBOR	1W--12M	ACT/365	2
JPY	Euroyen TIBOR	1W--12M	ACT/360	2
AUD	BBSW	1M--6M	ACT/365	0
DKK	CIBOR	1W--12M	ACT/360	2
DKK	LIBOR	O/N--12M	ACT/360	2
CAD	CDOR	1M--12M	ACT/365	0

TABLE 6.1. Ibor-like indexes.

1. LIBOR

LIBOR is the acronym for London Interbank Offered Rate. LIBOR is calculated (by Thomson Reuters) on behalf of the British Bankers' Association. Major banks submit their cost of borrowing unsecured funds for 15 periods of time in 10 currencies (AUD, CAD, DKK, EUR, JPY, NZD, GBP, SEK, CHF, USD).

The conventions are the same for all currencies. *For all currencies other than EUR and GBP the period between Fixing Date and Value Date will be two London business days after the Fixing Date. However, if that day is not both a London business day and a business day in the principal financial center of the currency concerned, the next following day that is a business day in both centers shall be the Value Date.* The business day convention is *modified following* and the *end-of-month* rule applies. For all currencies except GBP, the day count convention is ACT/360.

Reference: `http://www.bbalibor.com/technical-aspects/fixing-value-and-maturity`.

2. GBP-LIBOR

The Fixing Date and Value Date are be the same (0 day spot lag). The day-count convention is ACT/365. The fixing date and value date are be the same.

3. EUR-LIBOR

The value date is be two TARGET business days after the fixing date.

4. EURIBOR

The day-count convention is ACT/360 and the spot lag is two days. The business day convention is *modified following* and the *end-of-month* rule applies. The related calendar is TARGET. There are 43 contributor banks. The rate are published at 11:00 a.m. (CET).
Reference: http://www.euribor-ebf.eu/euribor-org/about-euribor.html

5. AUD-BBSW

The rate is Bank Bill Rates (BBSW) and is published by the Australian Financial Markets Association . The maturities are between one and six months. The day-count convention is ACT/365 and the spot lag is one zero day. The business day convention is modified following bimonthly. The rates are published at 10:00 a.m.
Reference: http://www.afma.com.au/data/bbsw.html

6. DKK-CIBOR

CIBOR is the acronym for Copenhagen Interbank Offered Rate. It is a reference interest rate for liquidity offered in the inter-bank market (in Denmark) on an uncollateralised basis with maturities from 1 week to 12 months. NASDAQ OMX publishes Cibor on a daily basis at 11:00 AM. The Danish Bankers Association has the overall responsibility for Cibor.
Reference: http://www.finansraadet.dk
Reference: http://www.nasdaqomxnordic.com/obligationer/danmark/cibor/

7. JPY-TIBOR

TIBOR is the acronym for Tokyo Interbank Offered Rate. It is published by the Japanese Bankers Association. There are two types ot TIBOR: The "Japanese Yen TIBOR" rates reflect prevailing rates on the unsecured call market; the "Euroyen TIBOR" rates, the Japan offshore market. The JBA TIBOR is calculated by JBA as a prevailing market rate based on quotes for 13 different maturities (1 week, 1-12 months) provided by reference banks as of 11:00 a.m. each business day. The day-count convention is ACT/365 for the domestic market and ACT/360 for the Euroyen market.
Reference: http://www.zenginkyo.or.jp/en/tibor/the_jba_tibor/

8. CAD-CDOR

CDOR is the acronym for Canadian Dealer Offered Rate. CDOR is determined daily from a survey of nine market makers in bankers' acceptances (BA). The survey is conducted at 10:00 a.m. each business day, with the results being quoted on CDOR page of Reuters' Monitor Service by 10:15 a.m. on the same day. The day-count convention is ACT/365. The fixing date and value date are be the same (0 day spot lag).
Reference: http://www.m-x.ca/marc_terme_bax_cdor_en.php

Part 2

Exchange trades instruments

CHAPTER 7

Overnight index linked futures

The overnight index futures are linked to an average of overnight rates on a certain period (usually a calendar month).

1. Federal Funds Futures

The *30-Day Federal Funds Futures* (simply called Fed Funds futures) are based on the monthly average of overnight Fed Funds rate for the contract month. The notional is 5,000,000 USD. The contract months are the first 36 calendar months. They are quoted on CBOT for USD.

Let $0 < t_0 < t_1 < \cdots < t_n < t_{n+1}$ be the relevant date for the Fed Funds futures, with t_1 the first business day of the reference month, t_{i+1} the business day following t_i and t_{n+1} the first business day of the following month. Let δ_i be the accrual factor between t_i and t_{i+1} ($1 \leq i \leq n$) and δ the accrual factor for the total period $[t_1, t_{n+1}]$. The day count convention for the USD overnight is ACT/360.

The overnight rates between t_i and t_{i+1} are given in t_i by F_i^O. The future price on the final settlement date t_{n+1} is

$$\Phi_{t_{n+1}} = 1 - \frac{1}{\delta}\left(\sum_{i=1}^{n} \delta_i F_i^O\right).$$

The margining is done on the price multiplied by the notional and divided by the one month accrual fraction ($1/12$).

2. One month EONIA indexed futures

The contract was introduced in 2008 and is traded on Liffe.

The notional is EUR 3,000,000 and the underlying rate EONIA. The delivery month covers a European Central Bank (ECB) Reserve Maintenance Period. The number of available delivery months will be limited to the number of Reserve Maintenance Periods for which dates have been published by the ECB.

The Exchange Delivery Settlement Price (EDSP) is one minus the ESDP Rate. The EDSP rate is calculated as

$$\frac{1}{\delta}\left(\left(\prod_{i=1}^{n}(1 + \delta_i F_i^O)\right) - 1\right).$$

The code on Bloomberg is `OMA Cmdty` and on Reuters is •.
Reference: https://globalderivatives.nyx.com/contract/content/29179/contract-specification

CHAPTER 8

Interest Rate Futures Ibor based

The futures type described in this chapter are the Ibor-based futures, also called Interest Rate Futures. They are traded on CME for USD and JPY, on Liffe for EUR, GBP, CHF and USD and on Eurex for EUR. The dates related to those futures are based on the third Wednesday of the month[1], which is the *start date* of the Ibor rate underlying the future.

The rate is fixed at a *spot lag* prior to that date (see Table 6.1 for the different conventions); the fixing usually take place on the Monday or on the Wednesday itself. The fixing date is also the *last trading date* for the future. The *end date* of the Libor rate period is three months[2] after the *start date* (using the conventions associated with the relevant Ibor-index).

The margining process works in the following way. For a given *closing price* (as published by the exchange), the daily margin paid is that price minus the *reference price* multiplied by the notional and by the accrual factor of the future. Equivalently it is the price difference multiplied by one hundred and by the *point value*, the point value being the margin associated with a one (percentage) point change in the price. The reference price is the trade price on the trade date and the previous closing price on the subsequent dates.

The futures price in t is denoted Φ_t^j. On the fixing date at the moment of the publication of the underlying Ibor rates L_t^j, the future price is $\Phi_t^j = 1 - L_t^j$. Before that moment, the price evolves with demand and offer.

For three months futures, the nominal is 1,000,000 (500,000 for GBP and 100,000,000 for JPY) and the accrual factor is 1/4. For one month futures, the nominal is 3,000,000 and the accrual factor is 1/12. In both cases, the nominal multiplied by the accrual factor is 250,000 (125,000 for GBP and 25,000,000 for JPY). The value of one (percentage) point is 2,500 currency units (1,250 GBP and 250,000 in JPY).

The *tick value* is the value of the smallest increment in price. The price usually changes in 1.0 or 0.5 basis points increments.

The futures are designated by character codes. The first part depends on the data provider and is usually two to four characters. The main codes are given in Table 8.1. The second part describes the month, with the codes given in Table 8.2, and the year, with its last digit. As interest rate futures are quoted up to 10 years in the future only, there is no ambiguity by using only one figure for the year. Note also that it means that when a future reaches its last trading date, a new one is created a couple of days later with the same name but for a maturity 10Y in the future.

[1] When the day is a non-good business day, it is adjusted to the following day.

[2] Futures exist also on the one month Ibor, but the most popular are on three months.

Currency	Tenor	Exchange	Underlying	Notional	Bloomberg	Reuters
USD	3M	CME	LIBOR	1,000,000	ED	•
USD	1M	CME	LIBOR	3,000,000	EM	•
USD	3M	SGX	LIBOR	1,000,000	DE	•
EUR	3M	Eurex	EURIBOR	1,000,000	FP	•
EUR	3M	Liffe	EURIBOR	1,000,000	ER	•
GBP	3M	Liffe	LIBOR	500,000	L␣	•
CHF	3M	Liffe	LIBOR	1,000,000	ES	•
JPY	3M	SGX/CME	TIBOR	100,000,000	EY	•
JPY	3M	SGX	LIBOR	100,000,000	EF	•
DKK	3M	OMX	CIBOR	1,000,000	CIB	•

TABLE 8.1. Interest rate futures on Ibor details and codes.

Month	Code	Month	Code	Month	Code
January	F	February	G	March	H
April	J	May	K	June	M
July	N	August	Q	September	U
October	V	November	X	December	Z

TABLE 8.2. Rate futures month codes.

CHAPTER 9

Interest Rate Futures Options: Premium

An option on future is described by the underlying future, an option expiration date θ, a strike K and an option type (Cap of Floor). The expiration is before or on the future last trading date: $\theta < t_0$.

The option on futures dealt with in this section are American type and pay the premium up-front at the transaction date. There is no margining process for the option. This type of option is traded on the CME exchange for eurodollar futures (one and three months).

There are three types of options: the quarterly options, the serial options and the mid-curve options. The quarterly options expire on the last trading date of the underlying future, i.e. $\theta = t_0$. The serial and mid-curve options expire before the future's last trading date. For the serial option, the delay is one or two months (plus one weekend). For the mid-curve option the delay is one, two or four years.

The quoted price for the options follows the same rule as the future. For a quoted price, the amount paid is the price multiplied by the notional and by the accrual factor of the underlying future.

CHAPTER 10

Interest Rate Futures Options: Margin

An option on future is described by the underlying future, the *option expiration date*, the *strike* and an option type (Call or Put). The expiration is before or on the future's last trading date.

The option on futures dealt with in this section are American type and have a future-like margining process. This type of option is traded on the Liffe for EUR, GBP, CHF and USD futures (three months) and Eurex for EUR (three months). The list of option types is provided in Table 10.1.

Ccy	Tenor	Exchange	Underlying	Type	Bbg	Rt
USD	3M	LIFFE	LIBOR	Option on future	FD	•
USD	3M	LIFFE	LIBOR	Mid-Curve Options	0D	•
EUR	3M	LIFFE	EURIBOR	Option on future	ER	•
EUR	3M	LIFFE	EURIBOR	Mid-Curve Options	0R	•
EUR	3M	LIFFE	EURIBOR	2 year Mid-Curve Options	2R	•
GBP	3M	LIFFE	LIBOR	Option on future	L␣	•
GBP	3M	LIFFE	LIBOR	Mid-Curve Options	0L	•
GBP	3M	LIFFE	LIBOR	2 year Mid-Curve Options	2L	•
CHF	3M	LIFFE	LIBOR	Option on future	ES	•

Bbg: Bloomberg code; Rt: Reuters code

TABLE 10.1. Interest rate future options details and codes.

Note that there are two margin processes involved in this instrument: one on the underlying future and one on the option itself.

The quoted price for the options follows the same rule as for the future. For a quoted price, the daily margin paid is the current closing price minus the reference price multiplied by the notional and by the accrual factor of the underlying future. The reference price is the trade price on the trade date and the previous closing price in the subsequent dates.

For the standard options (not mid-curve), the last trading date is the same as the last trading date of the underlying future. For the mid-curve options, the last trading date is one business day before the last trading date of the future in the same month.

For example the EUR mid curve options with expiry in Mar-2012 (0R12) on the Mar-2013 future (ER13), have a last trading date on the Friday 10-Mar-2012 while the Mar-2012 futures (ER12) and their associated standard options (ER12) trade up to Monday 13-Mar-2012.

CHAPTER 11

Bank bill futures (AUD style)

The AUD bill futures are traded on ASX. The futures settle physically. At expiry, different bills can be delivered. The bills eligible for delivery are bills with between 85 and 95 days to maturity at the settlement date. The issuers of the bills can be any bank in the approved banks list[1].

The party short of the future chooses the bill it wants to deliver[2]. The short party has a delivery option. This is a situation similar to the one in the bond futures in main currencies.

The *expiry date* θ (also called the announcement date) is the second Friday of the future month and the *delivery date* t_0 is the next business day (Monday).

Let $t_i (1 \leq i \leq N)$ denote the possible maturity dates of the bills[3]. At settlement the price received for the bill will depend of the last quoted future index that we denote F_θ. The yield associated to this index is $R_\theta = 1 - F_\theta$. The price paid is

$$\frac{1}{1 + \delta_i R_\theta}$$

where δ_i is the accrual factor associated to the dates t_0 and t_i. For AUD bill futures this factor is the number of calendar days between the two dates divided by 365. In exchange of the price the short party delivers the bill with a notional equal to the notional of the future[4].

Currency	Tenor	Exchange	Underlying	Notional	Bloomberg	Reuters
AUD	3M	ASX	Bank Bill	1,000,000	IR	•

TABLE 11.1. Futures on bank bills details and codes.

[1] There are currently four approved banks: Australia and New Zealand Banking Group Limited, Commonwealth Bank of Australia, National Australia Bank Limited, and Westpac Banking Corporation.

[2] Actually for each contract the short party can choose up to 10 different bills of AUD 100,000 each.

[3] In practice there are nine possible dates taking the weekend into account.

[4] The notional of the bill futures is AUD 1,000,000. This notional can be split into several physical bills, up to 10 pieces of AUD 100,000.

CHAPTER 12

Bond futures (non AUD/NZD)

Bond futures are exchange traded instruments. One of their particularity is that the underlying is not a single instrument but a basket. For most of the instruments, the short party has the option to deliver any of the instruments in the basket.

The basket is composed of government bonds from a unique issuer (country) with rules on their remaining maturity, initial maturity and issue size to be eligible.

The bond futures are traded on different exchanges for different countries. In general there are several maturity buckets for each underlying country. A list is given in Table 12.1.

Underlying country	Currency	Exchange	Number of contracts
United States	USD	CBOT	5
Germany	EUR	Eurex	4
United Kingdom	GBP	Liffe	3
Japan	JPY	TSE	3
Italy	EUR	Eurex	2
Japan	JPY	LIFFE	1
Canada	CAD	MSE	3
Switzerland	CHF	Eurex	1

TABLE 12.1. Main bond futures overview.

The bonds in the basket are transformed to be comparable through a conversion factor mechanism. The factor is such that in a certain reference yield environment all the bonds have the same price. The reference yield acts in a way like a strike for the delivery process.

There are other embedded options for some currencies. Some of those options are:

Timing option: The delivery notice can be done on a period and not only on one date. This gives some American option flavour to the futures.

Wild card option: The underlying bonds can be selected after the price of the future has been fixed. During the delivery period, there is a daily option between the end of future trading at 2 p.m. and the end of bond trading at 6 p.m. After the last trading, there can be a period (up to seven days) where the future price is fixed but the delivery notice is not given yet.

In the descriptions below, the texts in italic are quotes from the exchanges.

1. USD

The futures on United States debt are traded on the Chicago Board of Trade.

The description of the price used for delivery is: *The invoice price equals the futures settlement price times a conversion factor, plus accrued interest. The conversion factor is the price of the delivered bond (USD 1 par value) to yield 6 percent*.

The conversion factor is provided by the exchange and does not need to be computed by the users. Nevertheless there are clear rules to compute them. The values do not change through the life of the future.

Note that the last trading day and last delivery date are not the same for the all the underlyings. The delivery takes place one day after notice.

1.1. Long Futures. The Ultra T-Bond Futures, U.S. Treasury Bond Futures and 10-Year U.S. Treasury Note Futures have the same last trading date and last delivery day. The last trading day is the *seventh business day preceding the last business day of the delivery month. Trading in expiring contracts closes at 12:01 p.m. on the last trading day*. The last Delivery Day is the *Last business day of the delivery month*.

Previously the U.S. Treasury Bond futures referred to all bonds with maturities above 15 years. That range has recently (March 2011) been divided into two different futures.

1.2. Ultra T-Bond Futures. The underlying of the Ultra T-Bond Futures are *U.S. Treasury bonds with remaining term to maturity of not less than 25 years from the first day of the futures contract delivery month*.

1.3. U.S. Treasury Bond Futures. Formerly called the 30 years future, even if since March 2011 expiry, the deliverable grade for T-Bond futures are *bonds with remaining maturity of at least 15 years, but less than 25 years, from the first day of the delivery month*.

The Treasury Bond futures are less liquid than 10 and 5 years note futures (see Table 12.2). To match the US Treasury naming convention, the futures would be better called Note Futures.

1.4. 10-Year U.S. Treasury Note Futures. *U.S. Treasury notes with a remaining term to maturity of at least six and a half years, but not more than 10 years, from the first day of the delivery month.*

1.5. 5-Year U.S. Treasury Note Futures. The last Trading Day is *Last business day of the calendar month*. The last Delivery Day is the *third business day following the last trading day*.

The eligible bonds are *U.S. Treasury notes with an original term to maturity of not more than five years and three months and a remaining term to maturity of not less than four years and two months as of the first day of the delivery month.*

1.6. 3-Year U.S. Treasury Note Futures. The last trading day is *the last business day of the contract month*.

The nominal is USD 200,000. The eligible bonds are *U.S. Treasury notes that have an original maturity of not more than 5 years and 3 months and a remaining maturity of not less than 2 years and 9 months from the first day of the delivery month but not more than 3 years from the last day of the delivery month*.

1.7. 2-Year U.S. Treasury Note Futures. The nominal is USD 200,000. The eligible bonds are *U.S. Treasury notes with an original term to maturity of not more than five years and three months and a remaining term to maturity of not less than one year and nine months from the first day of the delivery month and a remaining term to maturity of not more than two years from the last day of the delivery month.*

Contract	Maturity	Nominal	Yield	Codes	Volume
Ultra T-Bond	$>$ 25Y	100,000	6.00%	UB/UL/UBE	2,104,788
30-YR Bond	15Y to 25Y	100,000	6.00%	ZB/US/	8,623,010
10-YR Note	6.5Y to 10Y	100,000	6.00%	ZN/TY/	26,546,008
5-YR Note	4Y2M to 5Y3M	100,000	6.00%	ZF/FV/	14,543,079
3-YR Note	2Y9M to 3Y	200,000	6.00%	Z3N/3YR	0
2-YR Note	1Y9M to 2Y	200,000	6.00%	ZT/TU/	6,083,142

The codes are for CME Globex (Electronic Platform)/Open Outcry (Trading Floor)/Clearing Code. The volume is the monthly volume for February 2012.

TABLE 12.2. USD bond futures.

2. EUR

In EUR, the futures are traded on Eurex.

A delivery obligation arising out of a short position may only be fulfilled by the delivery of certain debt securities issued by the Federal Republic of Germany with a remaining term on the Delivery Day within the remaining term of the underlying. To be eligible, the debt securities must have a minimum issue amount of EUR 5 billion.

The delivery day is *the tenth calendar day of the respective quarterly month, if this day is an exchange day; otherwise, the exchange day immediately succeeding that day.* The last trading day is *two exchange days prior to the Delivery Day of the relevant maturity month.*

The maturity ranges for the eligible bonds are given in Table 12.3. The futures names are: Euro-Buxl Futures, Euro-Bund Futures, Euro-Bobl Futures, and Euro-Schatz Futures.

Note that the reference yield for the Euro-Buxl, which is more recent than the others, is 4% (and not 6% like for the majority of futures).

Contract	Maturity	Nominal	Yield	Bbg	Rt	Volume
Euro-Buxl	24Y to 35Y	100,000	4.00%	UB	•	222,821
Euro-Bund	8.5Y to 10.5Y	100,000	6.00%	RX	•	11,778,488
Euro-Bobl	4.5Y to 5.5Y	100,000	6.00%	OE	•	7,252,498
Euro-Schatz	1.75Y to 2.25Y	100,000	6.00%	DU	•	8,659,722

The volume is the monthly volume for December 2011. Bbg: Bloomberg code. Rt: Reuters code.

TABLE 12.3. EUR bond futures.

3. GBP

The futures are traded on Liffe.

The *first notice day* is two business days prior to the first day of the delivery month. The *last notice day* is the first business day after the Last Trading Day. The *last trading day* is two business days prior to the last business day of the delivery month. The *delivery day* is any business day in delivery month (at seller's choice).

The deliverable bonds are subject to a coupon range of 3.00% around the reference yield.

Contract	Maturity	Nominal	Reference yield	Code	Volume
Long Gilt Futures	8Y9M to 13Y	100,000	6.00% / 4.00 %	G␣	476,025
Medium Gilt Futures	4Y to 6Y3M	100,000	6.00% / 4.00%	WX	183
Short Gilt Futures	1Y6M to 3Y3M	100,000	6.00% / 3.00%	WB	1,131
The volume is the monthly volume for December 2010. The change of coupon from 6% to a lower coupon took place with the December 2011 contract.					

TABLE 12.4. GBP bond futures

Contract	Maturity	Nominal	Reference yield	Code	Volume
20-year JGB Futures	15Y to 21Y	100,000,000	6.00%	?	?
10-year JGB Futures	7Y to 10Y	100,000,000	6.00%	JB	657,356
5-year JGB Futures	4.0Y to 5.25Y	100,000,000	3.00%	JJ	?
The volume is the monthly volume for February 2012.					

TABLE 12.5. JPY bond futures

4. JPY

The futures are traded on TSE.

The notional is JPY 100,000,000. The *final settlement* day is the 20th of each contract month. The *last trading day* is the 7th business day prior to each delivery date. Trading for the new contract month begins on the business day following the last trading day.

5. Settlement

Suppose there are N bonds in the basket. Let $\text{AccruedInterest}_i(t)$ denote the accrued interests of bond i for delivery date t. The conversion factor associated to each bond is denoted K_i. The bond future notice takes place in $\theta \leq t_0$. The time t *futures price*[1] is denoted by F_t. In the delivery, the short party can choose the bond he delivers (i) and receives at the delivery date in exchange of the delivery of the amount

$$F_\theta.K_i + \text{AccruedInterest}_{i^*}(t_0).$$

[1]The term *price* is the standard jargon for futures, but it would be more correct to speak of *number* or *reference index*. The future price is never actually paid. It is only a reference number for subsequent payment computation. The price could be shifted by an arbitrary amount without impact on the economy.

CHAPTER 13

Bond futures (AUD)

The Australian and New Zealand futures are settled in cash against a standardized bond. The standardized bond yield is computed as the average of actual bond yields for AUD and as a linear interpolation of actual bond yields for NZD.

1. Description

The AUD bond futures traded on SFE have very different characteristics. The main one is that they settle in cash versus they average yield of the underlying bonds. The exact mechanism of the settlement, which is not trivial, is described in the next section.

The average yield cash delivery implies that the futures behave roughly like a weighted average of the underlying. The weights are not exactly equal but they do not change too much with the rate level. One bond will never represent the future correctly but the mixture of bonds that best represent the future does not vary too much over time (and rates).

There exist two maturity types for the SFE Australian Treasury bond futures, the three (Bloomberg: `YMA<CMDTY>`, Reuters:) and the ten (Bloomberg: `XMA<CMDTY>`, Reuters:) year futures. Except for the maturity, all the characteristics of both futures are similar. Both have a notional of AUD 100,000 per contract. The three year future is usually more liquid than the ten year one.

The yield used in the settlement is fixed through a randomly selected list of dealer, excluding the extreme quotes. To our knowledge, the selection of underlying bonds is not subject to a very precise rule. A certain number of bonds are selected by the exchange. There are often around three underlying bonds. Their maturities are usually between two and four years for the three year futures and between eight and twelve for the ten year futures.

Reference: `http://www.asx.com.au/`

2. Future settlement

The time t *futures price*[1] is denoted by Φ_t. Suppose there are N bonds underlying the future.

All the margining payment related to SFE bond futures are done according to a reference bond price R_t computed from the future index in the following way. Let $m = 6$

[1] The term *price* is the standard jargon for futures, but it would be more correct to speak of *quoted number* or *quoted index*.

for the three year futures and $m = 20$ for the 10 year futures.

$$\begin{aligned} Y_t &= 1 - \Phi_t \\ v_t &= \frac{1}{1 + Y_t/2} \end{aligned} \tag{1}$$

$$R_t = 0.03 \frac{1 - v_t^m}{Y_t/2} + v_t^m. \tag{2}$$

In practice the reference price is multiplied by the notional, which is AUD 100,000 by contract.

The formula for R may seem artificial. It is simply the value of a semi-annual three (or ten) year bond with a C=6% coupon at a semi-annual yield of Y_t. The value is

$$\sum_{i=1}^{m} C/2 \frac{1}{(1 + Y/2)^i} + \frac{1}{(1 + Y/2)^m} = C/2 \frac{v - v^{m+1}}{1 - v} + v^m = C/2 \frac{1 - v^m}{Y/2} + v^m.$$

The contract settles in cash. The settlement is done against the average of the yield of the underlying bonds. Let $Y_{i,\theta}$ ($1 \leq i \leq N$) be the yields on the fixing date for the underlying bonds. The reference yield for the settlement is

$$Y_\theta = \frac{1}{N} \sum_{i=1}^{N} Y_{i,\theta}. \tag{3}$$

From the yield the final future index and equivalent bond price are computed as above.

Part 3

Over-the-counter instruments

CHAPTER 14

Forward Rate Agreement

Forward rate agreements (FRA) are OTC contracts linked to an Ibor-like index. At the trade date a *reference rate* (R), a start period, and a *reference index* are agreed. The end period is equal to the start period plus the index tenor (i.e a 6m start period and a 3m tenor give a 9m end period). The instrument *reference period* is computed in the following way. Its start date is computed from today by adding the index spot lag and then the start period (using the business day convention and calendar of the index). Its end date is computed from today by adding the index spot lag and then the end period. The *fixing date* (or exercise date) is the spot lag before the start date. The accrual factor between the start date and the end date (in the index day count) is denoted δ. In some (rare) cases the dates described above are not computed but decided arbitrarily by the counterparties (usually changing the dates by one day or two for convenience reasons).

The FRA *settlement date* is the start date (not the end date). On the settlement date the pay-off is, for the FRA buyer,

$$\delta \frac{L_\theta - R}{1 + \delta L_\theta}$$

where L_θ is the value of the reference index on the fixing date. The pay-off for the FRA seller is obviously the same amount with an opposite sign.

The term *FRA buyer* can be interpreted in the following way: the buyer pays a fixed price R and in exchange receives a good (the index rate L_θ).

Note that all the cash-flows are settled on the start date and not the end date. In some accounting schemes, the payment is accrued between the start date and the end date. The instrument stays "alive" from an accounting point of view even if it has already fully settled.

Note also that the end date underlying the fixing rate can be (slightly) different from the instrument end date due to non good business days.

CHAPTER 15

Interest rate swaps (Fixed for Ibor)

1. Leg payments

The dates on different instruments are spaced by a given payment period. Due to holidays, conventions and broken periods, the way to compute those dates should be detailed. The description below refers to the usual method; as the products are OTC, any variant is possible if agreed by the parties.

The dates are computed from the start (or settlement) date. The last date will be the start date plus the total length (tenor) of the leg. The intermediary dates are spaced by the given payment period except potentially one. The non-standard period is the first one. For example a 15 month leg with a 6 month period will pay after 3 (15-2x6), 9 and 15 months. The dates will be adjusted by the business day convention and the end-of-month rule. The non-standard period is called the *stub*. It can be *short* (shorter than one period) or *long* (between one and two periods). The reason the non-standard period is the first one is that once that period is finished, the instrument has the same date as a standard one. If the stub was the last period, the would never become a standard one. The term *roll* (like *29 roll*) is also used. It means that the (unadjusted) dates will be on the given day and not the one usual one. When it is used, it is often around the end-of-month.

The fixed for Ibor floating interest rate swaps exchange a leg of fixed payments for a leg of floating payments linked to a Ibor-like index.

The start (or settlement date) of the swap is usually a certain lag (called spot lag) after the trade date. The most used lag is two business days. The start date can also be forward. In that case the start date is the trade date, plus the forward period plus the spot lag. The forward period is a given number of months or of years.

The payments on the fixed leg are regularly spaced by a given period, most of them with a 6-month or 12-month period.

In fixed for floating swaps, the term *payer* and *receiver* refer to the fixed leg. A swap is a payer for one party if that party pays the fixed leg (and received the floating leg). A payer swap for one party is a receiver swap for the other party.

Like for FRA, the terms *buyer* and *seller* are also used. The swap buyer buys the floating leg for a given fixed price; he is the fixed leg (and swap) payer.

2. Vanilla swaps

In a vanilla IRS, all the coupons have the same notional and all the coupons on the fixed leg have the same rate.

The payments on the floating leg are also regularly spaced, most of them with 3 months or 6 months period. The period between the payments is equal to the Ibor index tenor. The fixing date for floating payment is the index spot lag before the period start date. The lag is the one given by the index and is usually the same as the swap spot lag.

Note that the dates of the fixing period corresponding to the deposit underlying the Ibor-index can be slightly different from the floating coupon period. The difference is created by the adjustments due to non-good business days.

The standard conventions for vanilla swaps in different currencies are provided in Table 15.1.

		Fixed Leg		Floating Leg		
Currency	Spot Lag	Period	Convention	Reference	Period	Convention
USD (NY)	2	6M	30/360	Libor	3M	ACT/360
USD (London)	2	1Y	ACT/360	Libor	3M	ACT/360
EUR: 1Y	2	1Y	30/360	Euribor	3M	ACT/360
EUR: $>$1Y	2	1Y	30/360	Euribor	6M	ACT/360
GBP: 1Y	0	1Y	ACT/365	Libor	3M	ACT/365
GBP: $>$1Y	0	6M	ACT/365	Libor	6M	ACT/365
JPY	2	6M	ACT/365	Tibor	3M	ACT/365
JPY	2	6M	ACT/365	Libor	6M	ACT/360
CHF: 1Y	2	1Y	30/360	Libor	3M	ACT/360
CHF: $>$1Y	2	1Y	30/360	Libor	6M	ACT/360
AUD: 1Y-3Y	0	3M	ACT/365	BBSW	3M	ACT/365
AUD: $\geq$4Y	0	6M	ACT/365	BBSW	6M	ACT/365
AUD	1	6M	ACT/365	Libor	6M	ACT/365
CAD	0	6M	ACT/365	CDOR	3M	ACT/365
DKK	2	1Y	30/360	Cibor	6M	ACT/360

The spot lag is the lag in days between the trade date and the first fixing period start date.

TABLE 15.1. Most frequent vanilla swap conventions.

3. In-arrears swaps

Another type of Ibor swaps is a swap with fixing in-arrears. In that case the start date for the Ibor period is the payment date. The fixing date for floating payment is the index spot lag before the period end date. The reference period for the Ibor index and the accrual period for the coupon are disjoint.

4. Short and long tenors

For some swaps, the period between payments is not equal to the index tenor. The payment period can be shorter than the index period (short tenor swap) or longer (long tenor swap). Typically this type of swap has a three-month payment period on a six- or twelve-month Ibor index (short) or an annual payment on a three- or six-month Ibor index (long). The short/long tenor swap can also be of the (fixing) in-advance or in-arrears type.

5. Step-up and step-down

The rate paid on the fixed leg coupons do not need to be the same for each coupon. The swap is called step-up when the coupons increase and step-down when they decrease.

6. Amortised, accruing and roller coaster swaps

The coupon notional does not need to be the same for all coupons. In most cases the notionals are the same for both legs over the same period.

If the notional is decreasing through time, it is called amortised swap. If the notional increase, the swap is called accruing. If the notional first increases and then decreases up to maturity, it is referred to as *roller coaster*.

CHAPTER 16

Swap indexes

The most common usage of these indexes is in Constant Maturity Swaps (CMS) and CMS cap/floors.

1. ISDA fixing

Swap rates for CHF, EUR, GBP, JPY and USD are established by ISDA in co-operation with Reuters (now Thomson Reuters) and Intercapital Brokers (now ICAP plc.). The main characteristics of the swaps are given in Table 16.1.

The main pages with the fixing are `ISDAFIX` on Reuters and `ISDA` on Bloomberg. The associated codes for some data providers are in Table 16.2.
Reference: `http://www.isda.org/fix/isdafix.html`

2. ISDA-EUR

There are four fixes: two for swaps vs Libor and two for swaps vs Euribor. For Libor the fixes are at 10:00 London time and 11:00 London time. For Euribor, they are at 11:00 CET-Frankfurt time and 12:00 CET-Frankfurt time. The maturities are 1 to 10 and 12, 15, 20, 25, 30 years. All the swaps are versus 6 months except the one year maturity which is versus 3 month.

3. ISDA-USD

There are two fixings, one at 11:00 New York time and one at 15:00 New York time. The maturities are 1 to 10 and 15, 20, 30 years. All the swaps are versus 3 months.

4. ISDA-GBP

There is one fixing, one at 11:00 London time. The maturities are 1 to 10 and 12, 15, 20, 25, 30 years. All the swaps are versus 6 months except the one year maturity which is versus 3 months.

5. ISDA-CHF

There is one fixing, at 11:00 London time. The maturities are 1 to 10 years. All the swaps are versus 6 months except the one year maturity which is versus 3 months.

6. ISDA-JPY

There are two fixings, one at 10:00 Tokyo time and one at 15:00 Tokyo time. The maturities are 1 to 10 and 12, 15, 20, 25, 30, 35, 40 years. All the swaps are versus 6 months. Note that for JPY there is also an 18 months fixing.

		Fixed Leg		Floating Leg			
Currency	Spot	Period	Conv.	Reference	Period	Conv.	Time
EUR: 1Y	2	1Y	30/360	Euribor	3M	ACT/360	11:00 CET
EUR: >1Y	2	1Y	30/360	Euribor	6M	ACT/360	11:00 CET
EUR: 1Y	2	1Y	30/360	Euribor	3M	ACT/360	12:00 CET
EUR: >1Y	2	1Y	30/360	Euribor	6M	ACT/360	12:00 CET
EUR: 1Y	2	1Y	30/360	Libor	3M	ACT/360	10:00 London
EUR: >1Y	2	1Y	30/360	Libor	6M	ACT/360	10:00 London
EUR: 1Y	2	1Y	30/360	Libor	3M	ACT/360	11:00 London
EUR: >1Y	2	1Y	30/360	Libor	6M	ACT/360	11:00 London
USD	2	6M	30/360	Libor	3M	ACT/360	11:00 New York
USD	2	6M	30/360	Libor	3M	ACT/360	15:00 New York
GBP: 1Y	2	1Y	ACT/365	Libor	3M	ACT/365	11:00 London
GBP: >1Y	2	6M	ACT/365	Libor	6M	ACT/365	11:00 London
CHF: 1Y	2	1Y	30/360	Libor	3M	ACT/360	11:00 London
CHF: >1Y	2	1Y	30/360	Libor	6M	ACT/360	11:00 London

The spot lag is the lag in days between the trade date and the first fixing period start date.

TABLE 16.1. Swap fixing details.

Currency	Time	Underlying	Bloomberg	Reuters
EUR	11:00 CET	EURIBOR	`EIISDAxx`	•
EUR	12:00 CET	EURIBOR	`EIISDBxx`	•
EUR	10:00 London	LIBOR	`ELISDAxx`	•
EUR	11:00 London	LIBOR	`ELISDBxx`	•
USD	11:00 New York	LIBOR	`USISDAxx`	•
USD	15:00 New York	LIBOR	`USISDP01`	•
GBP	11:00 London	LIBOR	`BPISDBxx`	•
CHF	11:00 London	LIBOR	`SFISDAxx`	•
JPY	10:00 Tokyo	LIBOR	`JYISDAxx`	•
JPY	15:00 Tokyo	LIBOR	`JYISDPxx`	•

In the Bloomberg code, the xx represent the tenor in years. The code should be followed by `␣Index`. The Reuters codes are the codes of the pages with the fixing, not the individual fixing values.

TABLE 16.2. Fixing sources pages and code.

CHAPTER 17

Overnight indexed swaps (OIS)

The overnight indexed swaps (OIS) exchange a leg of fixed payments for a leg of floating payments linked to an overnight index.

The start (or settlement date) of the swap is a certain lag (called spot lag) after the trade date. The most common lag is two business days.

The payments on the fixed leg are regularly spaced by a given period. Most of the OIS have one payment if shorter than one year and a 12 month period for longer swaps. The payments on the floating leg are also regularly spaced, usually on the same date as the fixed leg. The amount paid on the floating leg is computed by composing the rates.

Let $0 < t_0 < t_1 < \cdots < t_n < t_{n+1}$ be the relevant date (all good business dates) in the leg period. Let δ_i be the accrual factor between t_i and t_{i+1} ($1 \leq i \leq n$) and δ the accrual factor for the total period $[t_1, t_{n+1}]$. The overnight rates between t_i and t_{i+1} are given in t_i by F_i^O. The paid amount is

$$\left(\prod_{i=1}^{n}(1+\delta_i F_i^O)\right) - 1$$

multiplied by the notional. The payment is usually not done on the end of period date t_{n+1}, but at a certain lag after the last fixing publication date. The reason of the lag is that the actual amount is only known at the very end of the period and payment lag is taken into account. The lag is usually the same as the payment lag.

In EUR the payment is one day after the end of the fixing period. This one day is computed as the last publication date, which is at the start of the last period and one day before the end of the last period, plus two lag days. In USD the payment is two days after the end of the fixing period. These two days are computed as the last publication date, which is at the end of the last period, plus two lag days.

The standard conventions for OIS are provided in Table 17.1.

	Fixed Leg			Floating Leg		
Currency	Spot	Period	Convention	Reference	Convention	Pay lag
USD $\leq$ 1Y	2	tenor	ACT/360	Fed Fund	ACT/360	2
USD $>$ 1Y	2	1Y	ACT/360	Fed Fund	ACT/360	2
EUR $\leq$ 1Y	2	tenor	ACT/360	EONIA	ACT/360	2
EUR $>$ 1Y	2	1Y	ACT/360	EONIA	ACT/360	2
GBP $\leq$ 1Y	0	tenor	ACT/365	SONIA	ACT/365	1
GBP $>$ 1Y	0	1Y	ACT/365	SONIA	ACT/365	1
AUD $\leq$ 1Y	0	tenor	ACT/365	RBA ON	ACT/365	1
AUD $>$ 1Y	0	1Y	ACT/365	RBA ON	ACT/365	1

The spot lag is the lag in days between the trade date and the first fixing period start date. The pay lag is the lag in days between the last fixing and the payment.

TABLE 17.1. Overnight indexed swap conventions.

CHAPTER 18

OIS indexes

The OIS indexes are reference rates for standard OIS.

1. EONIA swap index

An EONIA swap index is the average rate of rates provided by prime banks rounded to three decimal places, that each Panel Bank believes is the Mid Market rate of EONIA swap quotations between prime banks. It is quoted for spot value (T+2) and on an actual/360 day basis (with annual payments). The fixing time is 11.00 CET. The indexes cover swaps from one week to 24 months.

The indexes are computed by the Euribor-EBF association. The indexes were launched in 2005.

The rates are available on Bloomberg page EBF on Reuters page ●.
Reference: http://www.euribor-ebf.eu/eoniaswap-org/about-eoniaswap.html

CHAPTER 19

Swaptions

A *swaption* is an option on a swap. It is characterized by an exercise date and an underlying swap. The exercise date is on or before the swap start date.

The option gives its holder the right (but not the obligation) to enter in the underlying swap on the exercise date. In theory a swaption can be written on any underlying swap. In practice the large majority of swaptions are written on vanilla interest rate swap.

A strike is often associated with a swaption. The strike is then the common rate of all the fixed leg coupons. But the underlying swap could have a different rate for each coupon (in a step-up or step-down swap for example) and the term strike is then ill-defined.

The terms payer and receiver for a swaption refer to the payer/receiver feature of the underlying swap. A swaption is a payer/receiver swaption if the party long the option has the right to enter into a payer/receiver swap. Note that the payer/receiver flag refers to the long party and not "us". So if one is short a receiver swaption and the swaption is exercised, he enters into a payer swap (a receiver swap for the other party which is long the option). A payer swaption for one party is also a payer swaption for the other party.

A swaption exercise date and its underlying swap start date are computed in the following way for standard swaptions. The swaption is described by an exercise tenor and an underlying swap tenor (like 6 months by 10 years). The exercise date is computed as today plus the exercise tenor, using the relevant calendar and the business day convention of the underlying swap. The swap settlement date is computed as the exercise date plus the underlying swap (or swap index) spot lag.

There are several settlement methods for swaptions. The summary of those methods for the main currencies is given in Table 19.1.

1. Physical delivery swaptions

When the swaption is with *physical delivery*, at the exercise date the parties enter into an actual swap (the underlying swap).

2. Cash-settled swaption EUR/GBP - yield-settled swaption

When the swaption is *cash-settled* a cash amount is paid (by the short party to the long party) at the exercise date (or more exactly at the spot lag after the exercise) and the actual swap is not entered into.

The cash amount to be paid to the long party is computed from a swap fixing rate using a conventional valuation formula of the theoretical underlying swap. The valuation is done using the swap fixing rate as an internal rate of return for the swap. The cash-settled swaption can be written only on a vanilla swap with the standard convention. This is the standard convention for EUR and GBP.

This cash-settlement approach is also called *yield-settled* in the US.

For a swaption with strike K and maturity M, the amount paid for a fixing S is

$$G(S)(\omega(S-K))^+$$

where $G(S)$ is the cash-annuity

$$G(S) = \sum_{i=1}^{Mm} \frac{\frac{1}{m}}{(1+\frac{1}{m}S)^i}$$

and m the number of payments by year.

3. Cash-settled swaption USD

The term cash-settle can also refer to another way to compute the cash amount. This second approach is usually used for USD cash-settled swaptions.

The cash-amount to be exchanged is calculated as the value of the underlying swap. To value the swap a full yield curve (and not only one rate) has to be agreed by the parties.

Currency	Method	Sub-method
EUR	Cash-settled	Internal rate of return
GBP	Cash-settled	Internal rate of return
USD	Cash-settled	Exact curve
AUD	Physical delivery	
Note.		

TABLE 19.1. Swaptions settlement conventions

4. Up-front and forward premium

The standard for the swaption premium has been for a long time a *spot* payment. The premium relative to the option paid by the buyer to the seller was done at the spot date from the trade date. With the crisis that started in 2007, the credit risk awareness increased and most of the major dealers decided to change the standard to a forward premium. The premium is paid at the same date the swaption itself is settled. This is in general at the spot date from the exercise date.

CHAPTER 20

Constant Maturity Swap (CMS)

The constant maturity swaps (CMS) are in some way similar to standard interest rate swaps. The swap is composed of two legs. Each leg has its own payment type. One leg is generally a fixed leg or an Ibor leg. The other leg is a floating leg the rate of which is based on an swap index (see Chapter 16).

The difference with a standard Ibor leg is that the rate on which the index is based can be very different from the period on which it is paid. The CMS floating leg usually pays on a quarterly or semi-annual basis a swap rate. The most popular swap indexes are the indexes based on 2, 5, 10, 20 and 30 year swaps.

The details of the fixing and payment are similar to those of Ibor coupons. The coupons can be with fixing in-advance or in-arrears. For the fixing in-advance the fixing takes place at the start of the accrual period. For the fixing in-arrears, the fixing takes place at the end of the accrual period. The lag between the reference date and the fixing is the spot lag of the swap index. Those spot lags are given in Table 16.1.

In EUR, the most popular CMS have quarterly payments on both legs. The non-CMS leg is three months Euribor.

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About OpenGamma
OpenGamma is the developer of the OpenGamma Platform, a next-generation platform for Unified Financial Analytics.
The OpenGamma Platform provides a modern, open architecture for building analytic solutions to end users in trading and risk management. It combines data management, a declarative calculation engine, and analytics in a single comprehensive solution.

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