STIR FUTURES
Trading Euribor and Eurodollar futures
FULLY REVISED SECOND EDITION
Sample
STIR Futures

Trading Euribor and Eurodollar futures

By Stephen Aikin
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About the Author

Stephen Aikin has been a derivatives trader for over 20 years and has worked as a professional training consultant for the last five, delivering finance and derivatives courses to leading institutions in London, Zurich and New York.

He started his career working for several investment banks. In 1988 he became a member of the London International Financial Futures Exchange (Liffe), where he started trading STIR futures on German interest rates. Stephen has specialised in relative value trading – both intra- and inter-contract – and has experienced consistent profitability over 20 years.

He is educated to MSc (Finance) level and holds several professional qualifications in the finance sector.
Preface

Who this book is for

This book is written for the aspiring trader but will also appeal to the experienced trader looking for a new market or trading strategy. Even those traders already experienced in trading STIR futures might find new inspiration and trading ideas from the sophisticated strategies presented in the trading section.

The learning curve is steep and constant, but all the information and concepts needed by the aspiring trader are presented simply and should be easily understood. Some prior knowledge of buying and selling securities might be helpful. The websites of the futures exchanges listed in the Appendices are useful sources of introductory information.

What this book covers

This book does not pretend to be a guide to making a trading fortune, and neither is it selling a trading system. Instead, it is a comprehensive guide to STIR futures markets, showing how professional traders can profit from their unique characteristics, particularly by using spreads and similar trading strategies. It details all the necessary tools and methodologies for these sophisticated trading strategies, appealing to the experienced STIR futures trader, whilst also providing guidance for the aspiring trader.

The majority of trading examples used in the book can be calculated by the use of pre-built functions that are standard within Microsoft Excel, rather than assuming that everyone has access to expensive subscription-based quantitative software.

How this book is structured

The book consists of four parts, designed to be read sequentially. Readers can dip into various sections but might find references to methodologies described earlier.

1. STIR Futures

Part 1 is a broad introduction to STIR futures, describing what they are, where they are traded, how they are priced, and how they can be used to hedge borrowing or lending exposures. This is followed by a comprehensive review of the drivers of STIR
futures, which describes the underlying influences that create price movement and how this should be interpreted by traders.

2. The Mechanics of STIR Futures

Part 2 is concerned with the mechanics of the STIR futures markets, including clearing and settlement procedures, how the markets are accessed, the software options available, and what influences the choice of STIR futures contracts to trade.

3. Trading STIR Futures

Part 3 is the trading section, with the majority comprising a thorough analysis of the spread relationships that exist both within STIR futures and against other interest rate products. STIR futures are often described as the ‘building blocks of finance’, which makes them perfect for spread trading, providing many more trading permutations with lower risk profiles than traditional directional trading instruments.

4. Trading Considerations of STIR Futures

Part 4 covers trading considerations and provides insights into the marketplace and its population, characteristics and the trading decision-making process.

The Appendices supply extra detail, including contact information, for those interested in taking matters further.

Supporting website

A website supporting this book can be found at www.stirfutures.co.uk.
Introduction

Most people are only aware of interest rate changes when they make the newspaper or television headlines, but interest rates are moving all the time. They are driven by the supply and demand of money being borrowed and lent in the money markets. STIR futures are one of the key financial derivatives in this market.

STIR futures first appeared in the 1980s as the Eurodollar contract, based on US interest rate deposits traded on the Chicago Mercantile Exchange (CME). CME’s success encouraged European emulation, resulting in the formation of the London International Financial Futures Exchange (now NYSE Liffe but referred to as Liffe in the text) in the early eighties and the creation of the Short Sterling (UK rates), Euromark (German rates), Euroswiss (Swiss rates) and Eurolira (Italian rates) STIR futures.

All futures were then traded by a method called open outcry. This involved the shouting out of order flow into a circular pit populated by traders wearing the colourful jackets of their company’s livery. Nowadays, almost all trading is computerised, creating a global virtual trading pit with no restriction on the number of participants it can hold. Consequently, STIR futures volumes have exploded in recent years. Arguably they are now the largest financial market in the world. It is not unusual for the leading STIR futures contracts, the Eurodollar and Euribor, to each trade over two trillion dollars’ or euros’ worth of interest rate transactions every day. Compare that with the $150 billion traded on a good day at the New York Stock Exchange, or even with the entire foreign exchange market, which trades approximately $3-trillion-worth per day, and it gives a clear idea of just how large the STIR futures markets are.

However, STIR futures are unique amongst financial markets in that individual traders can compete and trade on equal terms with other participants such as banks and large funds. It is a completely level playing field – unlike other markets, remaining free from domination by middlemen and market makers. Today’s fully computerised STIR futures markets support a global network of professional individual traders who benefit from the unique characteristics of these markets. Traders are not restricted to using a broker’s service or trading platform but can directly buy and sell into the central marketplace with similar technology and market information as the largest players.

Futures are often perceived as being highly risky trading instruments. This is not helped by the rogue trader scandals of the likes of Leeson, Kerviel and Adoboli, who between them lost $10 billion fraudulently trading futures. Futures have also made
it to the silver screen; Hollywood has glamorised futures trading in films like *Trading Places* and *Rogue Trader*. On celluloid, futures trading is highly speculative and an easy route to bankruptcy.

Admittedly, futures can be extremely risky instruments, especially if over-leveraged, but they are a broad class. It is unfair to categorise all futures as having the same risk profile. STIR futures are lower risk than most other types of futures contract and they can provide a lower trading risk profile than shares, currencies or spread betting. They do this by providing consistent returns from a diverse range of low-risk strategies not available in any other financial market.

Recent years have seen a growing number of individuals trading STIR futures for their own account, attracted by the professional direct market access and level terms of competition. Some traders have been very successful. Many more are content with an attractive and flexible lifestyle. Of course, some aspiring traders have discovered that a life in the markets is not for them. But the vast majority of people who leave it behind do so as a personal decision and not because of outlandish losses to be read about in the media.

Hopefully, this book will provide you with the knowledge to trade STIR futures intelligently, allowing you to make your own informed decision about this unique market and financial instrument.
1. STIR futures comprise one of the largest financial markets in the world. The two largest STIR futures contracts, the Eurodollar and Euribor, regularly trade in excess of one trillion dollars and euros each day.

2. The STIR futures markets are fully computerised, allowing easy global access.

3. Professional STIR future traders need a minimum capital of approximately £25,000 to start trading their own account, though sometimes nothing is required to join a trading arcade’s proprietary trading scheme.

4. STIR futures are one of the lowest-risk financial futures contracts and trading spreads or similar strategies provides an even lower risk profile. Trading STIR futures can provide more frequent and consistent returns with lower risk than most other kinds of financial product.

5. STIR futures are essentially financial building blocks. This makes them very suitable for trading against each other or other interest-rate contracts. The sheer number of trading permutations offered by their range of contracts and spreads allow traders to find their own professional niche.
STIR Futures
Introduction to STIR Futures

What are futures?

Futures are derivatives, meaning that they derive their value from an underlying asset like a commodity such as oil or a financial asset such as a bond, stock index or interest rate.

Futures are traded on regulated futures exchanges such as Liffe in London or CME in the United States and are structured as legally binding contracts. This means a counterparty to a trade undertakes to physically or notionally make or take delivery of a given quantity and quality of a commodity at an agreed price on a specific date or dates in the future.

What are STIR futures?

STIR futures are a variety of future contract where the underlying asset is a Short Term Interest Rate.

A short-term interest rate (STIR) futures contract can be defined as:

- a legally binding contract
- notionally to deposit or borrow
- a given amount of a specified currency
- at an agreed interest rate
- on a specific date in the future
- for a specified period.

For example, the three-month Euribor futures contract traded on Liffe is:

- a legally binding contract
- notionally to deposit or borrow €1m
- at an agreed interest rate
- on the delivery date
- for a nominal 90-day period.
This effectively means that a Euribor future provides a mechanism for locking in a forward borrowing or lending rate for a specified amount of euros on a given date for a nominal 90-day period.

This contrasts with a spot borrowing or lending for 90 days, which would be fully funded and unsecured, starting today for 90 days.

Similarities with other futures contracts

STIR futures are similar to other futures contracts in that they are:

- traded on regulated futures exchanges that provide the legal framework, contract specifications and the trading mechanism
- settled via a central counterparty to remove credit risk between market participants
- characterised by a unit of trading, tick size and settlement procedures.

Differences with other futures contracts

STIR futures differ from other futures in that they:

- have multiple delivery cycles, sequential to several years, covering a broad spectrum of the near-dated yield curve; this means that STIR futures have many different expiries trading simultaneously within the same contract, which allows a unique trading perspective
- have highly similar risk characteristics between delivery cycles
- include spread trading and other trading strategies, allowing many different trade permutations and ideas, with different risk profiles
- are arguably the most liquid class of futures by nominal value.
Derived from interest rates

Futures are broadly classed as derivatives since they are derived from another product; and are called futures since they are not for immediate purchase or sale but at a future date.

STIR futures are derived from interest rates covering a deposit period of three months, extending forward from three months up to ten years. These interest rates refer to near-term money market interest rates which are comprised of the unsecured inter-bank deposits markets (also known as the depo market). From these money markets comes the daily fixing of London Inter-Bank Offered Rate (LIBOR), or its European equivalent: European Inter-Bank Offered Rate (EURIBOR). These are the reference rates that are used to settle STIR futures on expiry.

LIBOR

The London Inter-Bank Offered Rate is defined as the rate of interest at which banks borrow funds from other banks in reasonable market size (e.g. $5m) in the London inter-bank market just prior to 11am London time. It is considered a key benchmark rate in the financial markets, having been in widespread use since 1984. LIBOR covers ten currencies with 15 maturities up to 12 months and is used as the basis for pricing a variety of interest rate products such as floating-rate notes, interest rate swaps, interest rate caps and floors and exchange-traded STIR futures and options.

Reuters acts as official fixing agent on behalf of the British Bankers Association. It determines LIBOR fixings by obtaining rates from contributor banks prior to 11am and these contributed rates are ranked in order, with the top and bottom quartiles removed and the remaining rates arithmetically averaged.

EURIBOR

EURIBOR is very similar to LIBOR but is the market standard for the euro. It was established by the European Banking Federation and ACI with the first EURIBOR rates quoted on 4 January 1999.

The fixing process is similar to LIBOR, with the following differences:

- panel of around 44 of the most active banks in the euro zone area
- this leads to a greater ratio of smaller banks to larger banks in comparison to LIBOR
- computed as an average of quotes for 15 maturities with the top and bottom 15% rejected (rather than top and bottom 25% as with LIBOR)
- published at 11am (CET) daily.
The LIBOR fixing scandal (2012) will lead to a regulatory reform of the LIBOR and EURIBOR fixing processes. It is highly likely that responsibility for LIBOR will be removed from the British Bankers Association and there will be changes to the fixing methodology.

Movement of interest rates

The following chart shows how these LIBOR rates for UK, USA, Swiss and EURIBOR rates have moved over time and how they have been influenced by major events.

It can be seen that country interest rates are influenced by the state of their economies and market expectations for interest rate levels in the future. Sharp movements are often caused by economic or political events. UK interest rates fell sharply in 1992 when sterling withdrew from the European Exchange Rate Mechanism (ERM) and global rates were cut sharply after 9/11 in 2001, after the tech market collapse in 2002 and the credit crunch in late 2008.

Fig. 1.1 – Three-month LIBOR rates for GBP, USD, CHF and three-month Euribor for EUR

Traded on exchanges

STIR futures are traded on regulated futures exchanges, such as London International Financial Futures Exchange (Liffe) in the UK or the Chicago Mercantile Exchange (CME) in the USA. Nowadays virtually all contracts are transacted electronically via
computerised trading. These exchanges provide the mechanism and legal framework for access to their particular markets.

Different exchanges have different STIR products, usually determined by their geographical origins. Euribor futures (based on European interest rates) are traded on Liffe and the Eurodollar futures (based on US interest rates) are mainly traded on CME. However, competition between exchanges can mean that popular contracts are sometimes quoted on several exchanges.

Buyers and sellers of STIR futures connect to these exchanges, either directly as members of the exchange or indirectly using a member as an agent. These buyers and sellers can be banks, corporate treasurers or speculative traders such as hedge funds, proprietary groups or individuals, formerly called locals but now known as liquidity providers (LP). These speculative traders attempt to make money from price action, whereas banks and treasurers tend to use the markets as hedging tools to risk-manage other interest rate exposures.

Exchange-traded futures are often portrayed as having no inherent counterparty risk. Generally this is true for exchange members, since credit risk between the counterparties to a trade is removed by the intermediation of a highly capitalised clearing house, which effectively guarantees each side of the deal, meaning that a buyer of a futures contract need not worry about the creditworthiness of the seller and vice-versa.

However, traders who are not exchange members but use the services of one to access the markets can be at risk of default by the exchange member.

Where and how are they traded

Futures on short-term interest rates are traded by exchanges all over the world, including Europe, the United States, South America, Australia, Asia and Japan. A list of some of these futures is included in the Appendices.

Focus on the big two contracts

Not all contracts are of equal trading stature. Some are a lot larger and more liquid than others and some, although being large and liquid, are not readily accessible or are of different contract design. Examples of the former include Euroyen, and of the latter Australian 90-day bank bills.

Consequently, this book will focus on the two biggest contracts, namely the Euribor future traded on the UK-based Liffe and the Eurodollar future traded on the US-
based CME. Other notable STIR futures are Short Sterling on UK rates and Euroswiss on Swiss rates, both traded on Liffe. They are virtually identical in operation and design as the Euribor or Eurodollar, with slightly differing contract specifications. Understand Euribor and Eurodollar futures and you will understand all STIR futures.

As can be seen in the contracts table in the Appendices, some like Eurodollar and Euribor are traded on two or even three exchanges. Most exchanges will try to capture business from other exchanges where they think they may have a competitive advantage, such as time zone or cross-margin incentives. However, even though the computerisation of futures trading has become a global phenomenon, the main pool of liquidity usually remains with the domestic exchange. The UK-based Liffe, hosting the European Euribor contract, is not really an exception given London’s status as the capital of Europe’s financial markets.

Trading is now computerised

STIR futures used to be traded by open outcry, mainly by loud young men in even louder coloured jackets on crowded trading floors. With the advent of computerisation, the vast majority of STIR futures are now traded electronically. The exceptions tend to be where some degree of negotiation is required during a transitional phase from floor to screen – examples being back-month trading or complex strategies.

Most exchanges’ computer systems have an application program interface (API) architecture that allows third parties to build software to run on it. This has led to a market of independent software vendors (ISV) plying a variety of commercial packages, offering the trader connectivity to the majority of exchanges from most major locations. However, unless the trader is a full clearing member of an exchange, he will need to appoint a clearing agent to process and guarantee his trades. This agent is usually a larger financial entity and will assume the trader’s risk based on a capital deposit in return for transaction-based commissions.

Directories of clearing members/agents and ISVs can be found on the accompanying website www.stirfutures.co.uk.
Contract structure and general specifications

The selling and buying of STIR futures represents a notional borrowing or lending from the money markets. They confer the borrowing or lending at a rate determined by the price at which the future was transacted, for a period of three months after the expiry and settlement of the contract, effectively a forward interest rate.

They are notional in the sense that they are cash settled and so a holding of STIR futures is not used to physically lend or borrow money from the markets. Instead, this notional value or unit of trading, usually a denomination of one million, is used as a proxy. The futures will mirror movements in the underlying market and provide a representative profit and loss.

Contract specifications for the four main STIR futures can found in the appendices. The US Eurodollar specifications are listed below for illustration.

Contract specifications for the Eurodollar contract

Table 1.1 – US Eurodollar contract specifications

<table>
<thead>
<tr>
<th>Contract</th>
<th>Eurodollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange</td>
<td>CME</td>
</tr>
<tr>
<td>Notional value/unit of trading</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>Delivery months</td>
<td>March, June, Sept, Dec, four serial, making a total of 40 delivery months</td>
</tr>
<tr>
<td>Price quotation</td>
<td>100.00 minus rate of interest</td>
</tr>
<tr>
<td>Minimum price movement</td>
<td>0.005 (0.0025 on front month)</td>
</tr>
<tr>
<td>Tick value</td>
<td>$12.50 per half basis point</td>
</tr>
<tr>
<td>Last trading day</td>
<td>Second business day preceding the third Wednesday of the contract month</td>
</tr>
<tr>
<td>Delivery day</td>
<td>Two business days after the last trading day</td>
</tr>
<tr>
<td>Margins (November 2011)</td>
<td></td>
</tr>
<tr>
<td>Initial margin</td>
<td>$608–$1013</td>
</tr>
<tr>
<td>Maintenance margin</td>
<td>$450–$750</td>
</tr>
</tbody>
</table>
Explanation of the contract specifications

Exchange

The Eurodollar is traded on CME, part of CME group, a regulated futures exchange. CME Group is comprised of four designated contract markets (DCMs): CME, CBOT, NYMEX and COMEX. The Eurodollar contract is also listed on LIFFE.

Notional value/unit of trading

The unit of trading is the notional value attached to each STIR future, normally in denominations of one million dollars, euros or Swiss francs or £500,000 in the case of LIFFE Short Sterling. This unit of trading is the notional amount that would be nominally deposited or borrowed for three months at the contract’s expiry. But since STIR futures are cash settled, these amounts never actually change hands. These units of trading are never at risk and are integral to the contract design only in that they permit a minimum movement increment to be derived.

A Eurodollar future has a notional value of $1,000,000 and this number is used to calculate its minimum movement, usually one or one half of a basis point. The figure of $1,000,000 is multiplied by the minimum permitted increment as designated by the exchange, in this case 0.005% (half a basis point), and then by the quarterly expiry cycle, to give:

$$1,000,000 \times 0.005/100 \times 0.25 = 12.50$$

A basis point is one one-hundredth of one per cent (for example, the difference between 4.00% and 4.01%).

Delivery months/Expiry cycle

Each STIR future has a finite life and trades on a quarterly expiration cycle: March, June, September and December (usually denoted by the symbols H, M, U and Z respectively). The year is usually added to these symbols, so that the cycle in 2012 would be H2, M2, U2 and Z2 going into 2013 as H3, M3 and so on. Serial months in between do exist but are mainly aimed at specific users such as hedgers and often have much less liquidity than the quarterly expiries.
Price quotation and minimum price movements

Method of quotation

STIR futures trade as a quote of 100% minus the interest rate. For example, if interest rates were 4.50%, the futures would be quoted as 95.500.

This methodology provides price synchronicity to other interest rate products such as bonds, which fall as interest rates rise and rise as interest rates fall. If interest rates were suddenly cut by 0.25% or 25 basis points to 4.25%, the STIR future would rise to approximately 95.75.

Alternatively, the price of the STIR future can be used to back out an implied forward rate by 100% minus the STIR future price%. In the above case, 100% - 95.75% = 4.25%. This STIR futures price implies a forward interest rate of 4.25%, which should be interpreted as a forward starting deposit or borrowing rate and not as to what the market expects three-month LIBOR or EURIBOR to be in the future.

Can STIR futures ever trade above 100?

Yes, although by necessity this would infer a negative implied forward rate. However, this is exactly what happened in 2011 in the Euroswiss STIR future. As a consequence of the 2010/11 European sovereign debt crisis, global investors tended to avoid the euro and invest in ‘safe haven’ currencies like the US dollar, British pound and Swiss franc. Switzerland is a relatively small global economy and the effect of investors buying the franc drove it to high levels against the euro. The effect of an overvalued currency is to make exports uncompetitive and this affected the profitability of Swiss companies exporting into the European market.

The Swiss National Bank (SNB) responded in August 2011 by pegging the Swiss franc to the euro at a rate of €/CHF 1.20, meaning that if the franc were to appreciate (<1.20) against the euro, the SNB would intervene to sell unlimited amounts of Swiss francs against buying euros. One of the ways that the SNB facilitated this peg was to intervene in the forward FX market, selling Swiss francs for future delivery at a rate which implied negative interest rates against the spot exchange rate (see the later section on FX Swaps).

The Euroswiss futures responded by trading well above 100 during late 2011 and then normalised to around 100 since the three-month Swiss LIBOR, to which the contract settles at expiry, never actually went negative, only the forward rates.
Fig. 1.2 – Chart showing front-month Liffe Euroswiss STIR future (thick black line, upper pane, RH scale), €/CHF exchange rate (thin black line, upper pane, LH scale) and three-month Swiss LIBOR (black line, lower pane, RH scale)

Source: Reuters

Tick size

The smallest permitted increment is known as the minimum price movement and is expressed in basis points. Derived from this figure and the notional value of the contract is the tick value which is the monetary value of the minimum price movement.

In the case of the Eurodollar contract, the minimum movement is half a basis point with a tick value of $12.50. This can be expressed as:

\[ \$1,000,000 \text{ (unit of trading)} \times 0.005/100 \text{ (minimum price movement)} \times 0.25 \text{ (quarterly expiry cycle)} = \$12.50 \]

The nearest-dated Eurodollar front-month contract can trade in a quarter-of-a-basis-point tick value worth $6.25.

Tick values are known figures and do not need to be calculated by the trader. They are used to determine profit and loss and the risk sensitivity of the contract to changes in interest rates.

For example: If a trader were to buy one Eurodollar future at 95.50 and sell it at 95.51, they would have a profit of 2 ticks (1 basis point) or 2 x $12.50 = $25. If they had bought and sold two contracts at the same prices, the profit would be $50.
Price quotations

A quick look in the financial pages or exchange website might show the following quotes.

Table 1.2 – STIR futures example quote

<table>
<thead>
<tr>
<th>Month</th>
<th>Symbol</th>
<th>Price</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>H</td>
<td>95.50</td>
<td>95.48</td>
<td>95.53</td>
</tr>
<tr>
<td>Jun</td>
<td>M</td>
<td>95.45</td>
<td>95.43</td>
<td>95.48</td>
</tr>
<tr>
<td>Sep</td>
<td>U</td>
<td>95.41</td>
<td>95.39</td>
<td>95.44</td>
</tr>
<tr>
<td>Dec</td>
<td>Z</td>
<td>95.38</td>
<td>95.35</td>
<td>95.41</td>
</tr>
</tbody>
</table>

Each quarterly month has a price, which is the settlement price or closing price for that day’s business. Note that all four quarterly expiries trade concurrently and in relation to each other. The high and low values show the day’s range or the minimum and maximum prices traded during that session. However, this display is of historical prices from a previous trading session and if current price data were to be used, then the prices would appear something like this.

Table 1.3 – STIR futures example quote with current price data

<table>
<thead>
<tr>
<th>Month</th>
<th>Symbol</th>
<th>Bid</th>
<th>Offer</th>
<th>Last</th>
<th>Volume</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar</td>
<td>H</td>
<td>95.50</td>
<td>95.51</td>
<td>95.51</td>
<td>40555</td>
<td>+0.01</td>
</tr>
<tr>
<td>Jun</td>
<td>M</td>
<td>95.46</td>
<td>95.47</td>
<td>95.47</td>
<td>30667</td>
<td>+0.02</td>
</tr>
<tr>
<td>Sep</td>
<td>U</td>
<td>95.41</td>
<td>95.42</td>
<td>95.42</td>
<td>28909</td>
<td>+0.02</td>
</tr>
<tr>
<td>Dec</td>
<td>Z</td>
<td>95.39</td>
<td>95.40</td>
<td>95.40</td>
<td>18909</td>
<td>+0.02</td>
</tr>
</tbody>
</table>

Some notes on the quote:

- **Bid/offer spread**
  
The notable difference with the historic quote is the bid/offer spread. These are the selling/buying prices. The trader could sell March at 95.50 or buy it at 95.51, similar to the way shares are traded.

  The difference between the bid price and offer price usually reduces to the minimum price movement, in this example 0.01; but in Eurodollar or Euribor would be 0.005, such as 95.505 bid 95.510 offered.
• **Last price**  
The last price shows where business is currently being transacted. In this case it appears to be buying at the offer price and this is supported by the change column depicting the positive difference between the last traded price and the previous settlement price.

• **Volume**  
The volume shows the liquidity in the market. In this example, the combined four months have traded a total of 119,040 contracts, each contract being based on a notional value of $1 million, €1 million or £500,000, depending on the contract specifications.

The examples above have only used the first four months for the sake of expediency. In reality, the prices extend out for several years on the same quarterly cycle to the extent dictated by their individual contract specifications.

The quarterly cycle is also colour coded, the first four quarters being called the whites, the next four being the reds, the next four being the greens, the next four being the blues and the next four being the golds – contract specifications permitting. Sequences of STIR futures are generically called *strips* and so the first four quarterly expiries can be called the white strip, followed by the red and green strips. However, strips can comprise any number of futures and not just be determined by colour.

<table>
<thead>
<tr>
<th>Code</th>
<th>Expiry year</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>First quarterly expiry</td>
<td>WHITE</td>
</tr>
<tr>
<td>M2</td>
<td></td>
<td>WHITE</td>
</tr>
<tr>
<td>U2</td>
<td></td>
<td>WHITE</td>
</tr>
<tr>
<td>Z2</td>
<td></td>
<td>WHITE</td>
</tr>
<tr>
<td>H3</td>
<td>Year 2 quarterly expiry</td>
<td>RED</td>
</tr>
<tr>
<td>M3</td>
<td></td>
<td>RED</td>
</tr>
<tr>
<td>U3</td>
<td></td>
<td>RED</td>
</tr>
<tr>
<td>Z3</td>
<td></td>
<td>RED</td>
</tr>
<tr>
<td>H4</td>
<td>Year 3 quarterly expiry</td>
<td>GREEN</td>
</tr>
<tr>
<td>M4</td>
<td></td>
<td>GREEN</td>
</tr>
<tr>
<td>U4</td>
<td></td>
<td>GREEN</td>
</tr>
<tr>
<td>Z4</td>
<td></td>
<td>GREEN</td>
</tr>
</tbody>
</table>
As time progresses, and the front contract expires, the contracts will move forward one place so that, for example, on the expiry of the H2, the M2, U2, Z2 and H3 will be the new white strip.

**Last trading day and settlement**

The last trading day is the expiry of the STIR future and is normally 11am (London time) to coincide with the LIBOR fixing for that day. That LIBOR fixing will determine the exchange delivery settlement price (EDSP) as:

\[
100 - \text{three-month LIBOR fixing on expiry day}
\]

The settlement day is normally two business days after the last trading day to reflect the T (trade) + 2 days settlement convention in the London Interbank money markets. However, the settlement for any STIR futures is cash-based and never results in an actual borrowing or lending.

**Margins**

Buyers and sellers of STIR futures deposit margin with the clearing house, which acts as a guarantor of trades and largely removes counterparty risk from the exchange-trading process. Margin can be regarded as collateral against possible losses and the amount of margin depends on the size of open positions; it can be posted in cash or securities.

There are two primary forms of margin.

- **Initial margin** (also known as scanning risk)
  This is the deposit required to initiate either a short or long futures position reflecting the risk of the underlying future.

- **Variation margin**
  This is a daily profit and loss calculated on a mark to market basis.

Any profit will be credited to the margin account and may be withdrawn but any losses will be debited to the margin account and these losses might have to be covered if there is a margin shortfall.

There is another form of margin called **maintenance margin**.

If the funds remaining available in the margin account are reduced by losses to below a certain level, known as the maintenance margin requirement, a trader will be required to deposit additional funds to bring the account back to the level of the initial margin.
Maintenance margin levels tend to be around 75% of initial margins and act as a buffer for exchange members.

The Eurodollar futures contract specifications list the initial margin in December 2011 as being $608 to $1,013 and the maintenance margin as being $450–$750. The exact amount of margin will vary with the expiry month but the general premise is that the more volatile the contract, the higher the margin, and vice versa.

The following table shows four days of price movements for the Eurodollar to illustrate the margin cash flows process.

The initial margin is assumed to be $1,000 and the maintenance margin is $750. The tick size for the Eurodollar is $12.50 per half basis point.

**Day 1** – One Eurodollar is purchased to open at a price of 95.50 and the contract settles (closes) at the same price for that day. Consequently, there is no profit or loss and therefore no variation margin requirement but $1,000 must be lodged with the clearing house as initial margin.

**Day 2** – The price has gone up to 95.55, giving a mark-to-market profit of $125 (10 ticks x $12.50) which is credited to the margin account and could be withdrawn if required.

<table>
<thead>
<tr>
<th>Day</th>
<th>Closing price</th>
<th>Change on day (ticks)</th>
<th>P&amp;L on day</th>
<th>Variation margin</th>
<th>Total margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>95.500</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$1,000</td>
</tr>
<tr>
<td>Day 2</td>
<td>95.550</td>
<td>+10</td>
<td>$125</td>
<td>$125</td>
<td>$1,125</td>
</tr>
<tr>
<td>Day 3</td>
<td>95.450</td>
<td>-20</td>
<td>-$250</td>
<td>-$125</td>
<td>$875</td>
</tr>
<tr>
<td>Day 4</td>
<td>95.350</td>
<td>-20</td>
<td>-$250</td>
<td>-$375</td>
<td>$625</td>
</tr>
</tbody>
</table>

**Day 3** – The price has now fallen to 95.45, a loss of 20 ticks from the previous close. This is a loss of $250 (20 x $12.50), which is deducted from the margin account which is now reduced to $875. This is lower than the initial margin but higher than the maintenance margin so no action needs to be taken.

**Day 4** – The price has fallen further to 95.35, adding a further loss of $250. This reduces the total margin to $625, which is lower than the maintenance margin of $750 and therefore more cash needs to be added to restore the balance to the initial margin level ($1,000). Failure to do so might result in foreclosure of the position by the clearing house.
Buying and selling STIR futures

The principles of buying and selling STIR futures and spreads are similar to those of stocks, bonds or commodities. Buying low and selling high will return a profit, and selling high and buying low will do the same.

Futures are transacted to open or close. This is market terminology for entering and exiting trades. A purchase or sale to open is entering a new trade or position. A purchase or sale to close is exiting an existing trade or position. Remember that in futures markets, it is as easy to sell to open, as it is to buy to open.

For example: If one STIR future is purchased at 95.50 to open and sold at 95.51 to close, a profit is made.

- If this were a Liffe Short Sterling future, where one tick is equivalent to one basis point then the profit on the trade would be £12.50.
- If it were a CME Eurodollar, where one tick is equal to half a basis point with a tick value of $12.50, then the profit would $25 (2 x $12.50).

It is sometimes easier to think of STIR futures profits and losses in terms of basis point values (BPV). This is often referred to as duration, expressed per basis point, also known as DV01 (dollar value of one basis point) and is a measure of the sensitivity of the underlying instrument to a change of one basis point in interest rates.

One basis point on the Eurodollar and Euribor would be €25 and $25 respectively. Remember that these contracts have a tick value of €12.50 and $12.50 due to the fact that their minimum price increment is half a basis point. Therefore two ticks make a basis point.

One basis point on the Euroswiss and Short Sterling is worth CHF25 and £12.50 respectively, since both these contracts have a tick value equal to one basis point (Short Sterling is £500,000 contract size).

Consequently, the profit or loss on any STIR future can be calculated by:

\[
\text{Number of contracts} \times \text{difference between opening price and closing price in basis points} \times \text{BPV}
\]

For example, if 100 Euribor are sold to open at 96.62 and bought back to close the position at 96.605, the profit would be:

\[
100 \times 1.5 \times €25 = €3,750
\]
If 50 Short Sterling are bought at 95.45 and sold at 95.44, the loss would be:

$$50 \times 1 \times \£12.50 = \£625$$

Note how the difference between opening price and closing price is expressed in basis points; otherwise the results need to be multiplied by 100 to compensate for the basis point convention. The difference between 95.45 and 95.44 is one basis point.

**Buying and selling STIR futures as notional borrowings and lendings**

It is hardwired into STIR futures contract specifications that:

- selling = notional borrowing
- buying = notional lending.

This can be shown by extending the previous examples of buying and selling STIR futures and determining the resulting profit or loss.

A previous example stated that:

If 100 Euribor are sold to open at 96.62 and bought back to close the position at 96.605, the profit would be:

$$100 \times 1.5 \times \€25 = \€3,750$$

An alternative way to look at this is that the opening sale is a proxy for a notional borrowing of €100 million (100 x €1 million contract size) at a rate of 3.38% (100 - 95.62) for three months after the futures expiry.

The closing purchase is a proxy for a notional lending of €100 million (100 x €1 million contract size) at a rate of 3.395% (100 - 95.605) for three months (0.25 year) after the futures expiry.

Putting both sides of the trade together means that €100 million has been borrowed at 3.38% and lent out at 3.395% over the same forward period (three months being a standardised 0.25 of a year).

This would result in a profit of €100 million x (3.395% - 3.38%) x 0.25 = €3,750, the same as above.

**Introduction to spreads and strategies**

STIR futures are unique amongst financial markets in that they have many different expiry months trading simultaneously as part of the same contract. For example, a
STIR future such as the CME Eurodollar can have as many as 40 different quarterly expiries trading at the same time. All of these expiries are based on the same STIR future, and will have the same specifications, but will differ slightly in that they all have different expiries and so their prices will change at slightly differing rates according to underlying drivers such as changes in the term structure of interest rates.

These small differences in the price action between expiries give rise to the spread markets and related trading strategies.

Spreads

A *spread* is simply the differential between two expiries, created by buying one month and selling another. For example, a H2 future can be purchased and a M2 future sold in equal quantity, which will result in a H2M2 spread. If H2 was purchased at 95.51 and M2 sold at 95.46, the spread would be bought at a difference of 0.05 (95.51 - 95.46). This spread is called a three-month spread since there is three months’ difference between expiries. Spreads can have many different permutations such as six-month, nine-month and 12-months but are subject to some common rules.

The nearest dated expiry is always quoted first in the calculation of the spread price so that its formula will appear as:

\[ \text{Future}_{\text{nearest dated}} - \text{Future}_{\text{furthest dated}} \]

Spreads are quoted with a bid and offer price just like the outright futures contracts, but are quoted as a differential. They can be positive or negative and are quoted as separate instruments so that, for example, the H2 and M2 expiries will have individual quotations and so will the H2M2 spread. Trading the spread as an independently quoted contract involves the simultaneous transaction in both underlying months but with no execution risk.

The table shows some prices for the outright futures in the top box and some strategies in the lower box.

<table>
<thead>
<tr>
<th>Futures</th>
<th>Symbol</th>
<th>Bid</th>
<th>Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>H2</td>
<td>95.50</td>
<td>95.51</td>
</tr>
<tr>
<td>June</td>
<td>M2</td>
<td>95.46</td>
<td>95.47</td>
</tr>
<tr>
<td>Sept</td>
<td>U2</td>
<td>95.41</td>
<td>95.42</td>
</tr>
<tr>
<td>Dec</td>
<td>Z2</td>
<td>95.39</td>
<td>95.40</td>
</tr>
</tbody>
</table>
Table 1.7 – Quotes for standard STIR spreads

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Symbol</th>
<th>Bid</th>
<th>Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 month spread</td>
<td>H2M2</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>3 month spread</td>
<td>M2U2</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>6 month spread</td>
<td>H2U2</td>
<td>0.08</td>
<td>0.10</td>
</tr>
<tr>
<td>Butterfly</td>
<td>H2M2U2</td>
<td>-0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The three-month and six-month spreads are the differentials between the outright futures. Note how the bid/offer spreads in the two component outright futures of a spread will create a wider spread bid/offer, totalling the combined bid/offer spreads of the two futures. In reality, market participants would tighten these quotes.

**Butterfly**

The last entry in the lower table is a *butterfly*, which is a variation on a spread. Whereas a spread is the differential between two futures contracts, a butterfly is the differential between two spreads. It can be quoted in two ways, firstly as the difference between two spreads so that in the example above, it would be created by:

\[
H2M2 - M2U2
\]

Since the individual spreads are quoted as 0.03/0.05 and 0.04/0.06 respectively, the butterfly quote will be buying the first spread at 0.05 and selling the second spread at 0.04 to give an offer price of 0.01 (0.05 - 0.04) and a bid price of 0.03 - 0.06, equalling -0.03.

The second method of quoting the butterfly is by using the outright futures in the following formula:

\[
\text{(Future}_{\text{nearest dated}} + \text{Future}_{\text{furthest dated}}) - (2 \times \text{Future}_{\text{middledated}})
\]

So that the butterfly offer price would be:

\[
\text{(buying H2 at 95.51 + buying U2 at 95.42)} - (2 \times \text{selling M2 at 95.46}) = 0.01
\]

And the butterfly bid price would be:

\[
\text{(selling H2 95.50 + selling U2 at 95.41)} - (2 \times \text{buying M2 at 95.47}) = -0.03
\]

Spreads and other trading strategies will be examined in much more detail later in the book, but hopefully this introduction will have highlighted the many trading strategies.
permutations that spreads and strategies offer, as opposed to purely directional outright trading.

Spreads and butterflies carry lower risk than outright futures and can move in more predictable fashions, making them ideal instruments for the professional trader.

**A typical trader’s screen**

Although there are many different software packages offering access to the STIR futures markets, they are usually of a typical layout, and will be considered in greater depth later.

Fig. 1.3 – A typical STIR trading screen featuring Easy Active Trade from Easyscreen (www.easyscreen.com). Used with permission

This screenshot shows a Windows-based display with the principal trading windows as follows:

1. watch window showing Liffe Short Sterling futures
2. ladder window showing a single Liffe Euribor future
3. order ticket, in this case to buy 16 Z3 Short Sterling futures at 98.77
4. risk window showing positions, margin requirements and profit/loss
5. order book showing working and completed orders
6. spread matrix displaying permutations of Euribor spreads
7. big pull window, enabling deletion of all working orders across all markets.
The advantages of trading STIR futures compared to other financial products

Be a price maker, not a taker

The modern trader is faced with the choice of many products to trade. There are stocks and shares, contracts for difference, foreign exchange and options to name a few. However, there always seems to be a middleman getting in between the trader and the market, be it someone obvious like a stockbroker or something less tangible like a wide bid/offer spread on a currency quote. Most markets will only offer the non-institutional trader agency access, meaning that the trader will usually be required to trade off someone else’s price quotes, which creates an instant disadvantage. If a security is bought with a quoted selling/buying price of 50–52 at 52, there is an immediate loss since the selling price to exit the position is now 50. The trader might not want to sell immediately but there’s no denying that paper loss on a mark-to-market basis. Furthermore, the market needs to rise two points before a break-even point is reached. Add in a commission, if applicable, and it’s easy to understand why many traders fail. A trader would need to be right seven or eight trades out of ten to get ahead.

Futures offer a different approach to trading. Traders can still be price takers like in the example above, but they can also be a price maker. This means that the trader can be the party quoting 50–52, hoping that someone sells to him at 50 or buys from him at 52. It’s immediately apparent that this can be a much more advantageous way to trade, particularly when, in reality, the huge liquidity of STIR futures markets creates a tight bid/offer spread which gives guidance as to where the market is and, most importantly, has other buyers and sellers bidding and offering the same prices in case the trader wishes to close out the position. Traders also have the benefit of being able to sell short just as easily as buying long. There are no additional costs involved.

Deep liquidity

STIR futures are amongst the most liquid financial markets in the world. It is virtually unheard of not to have a liquid market in all conditions, even in times of economic or political turmoil. Indeed, events that might cause problems in other financial markets, such as 9/11 (which closed the NYSE), led to huge trading volumes in global STIR futures. STIR futures also remained liquid during the worst moments of the financial crisis of 2007/8.
The liquidity of STIR futures is based on the cumulative order flow of thousands of traders and institutions, and not just quotes provided by a few market makers. This means that large orders, for example trades of between 1000 and 10,000 lots (1 to 10 billion of notional value) can trade at any one time, particularly in the larger Euribor or Eurodollar contracts and are usually easily absorbed by the markets.

A mathematical dependency

STIR future prices have a very clear reference to their underlying interest rates and market expectations for future interest rate levels, which provides traders with a good idea of their value, either absolutely or relative to each other, as in the case of spread trading.

Low costs

Trading costs are low for trading relatively large amounts of interest rate futures. To buy and sell one lot of Euribor (which is €1m notional of interest rate futures) would cost approximately €0.75 to €1.50, but would yield a potential profit (or loss) of €12.50 on a minimum movement. Trading rebate schemes can reduce these fees substantially.

Lower volatility

STIR futures have much lower volatilities than most other financial markets, meaning that they move around a lot less. The following chart shows the volatilities for the Eurostoxx 50, a European stock market index and Euribor futures. The Eurostoxx 50 volatilities range from a norm of around 20% to almost 100% in times of financial turmoil, whereas the Euribor futures are much less volatile (annualised price volatilities usually less than 1%) perhaps making it a more predictable product to trade.
Many trading permutations

All these advantages can apply to most financial futures, but STIR futures offer further trading advantages. Because they have multiple expiries listed on the same contract, this offers the trader more choices. He could sell H2 or M2, or buy red September or buy green December. Indeed, many traders specialise in trading certain maturity cycles such as the reds or greens, rarely trading the front whites. Traders can also trade one maturity or expiry against another. For example, you might purchase H2 and sell M2 against it to trade the spread between the two contracts. You might buy H2, sell M2, sell M2 and buy U2 and trade the differential between the two spreads. It doesn’t stop there. There are many trading permutations within STIR futures, which allow the traders to find a niche for themselves. However, make no mistake, there is little easy money in STIR futures. Subsequent chapters will look at the trading of STIR futures in much greater detail but first it is important to appreciate how STIR futures are priced relative to the underlying interest rates.
STIR Futures Pricing

Spot and forward rates

STIR futures settle to three-month LIBOR or EURIBOR and their prices should be derived from the rates underlying the LIBOR/EURIBOR fixing process, and those interest rates are short-term rates from the money markets. Money markets comprise both cash deposits rates (also known as depos or spot rates) and money market instruments. It is the former with which this section is primarily concerned.

Deposit rates

Most readers will be familiar with the concept of deposit rates. A bank will offer the depositor a choice of term and interest rate for the money. Usually, but not always, the longer the money is left, the higher the interest rate that is received. This depends on the outlook for interest rates but, generally, depositors will be rewarded with higher rates for the longer they leave their money. This shape of the deposit rate structure (or yield curve) where long-term rates are higher than short-term rates is termed positively sloping. The deposit rate will be fixed for the term of the deposit. The following table shows the some example deposit rates for euros.

Table 1.8 – Example of Euro Interbank rates

<table>
<thead>
<tr>
<th>Term</th>
<th>Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month</td>
<td>4.45</td>
</tr>
<tr>
<td>2 months</td>
<td>4.52</td>
</tr>
<tr>
<td>3 months</td>
<td>4.54</td>
</tr>
<tr>
<td>6 months</td>
<td>4.58</td>
</tr>
<tr>
<td>9 months</td>
<td>4.62</td>
</tr>
<tr>
<td>12 months</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Let's say an author agreed a €200 advance for a book. Half is receivable today, and the other half in nine months' time when the manuscript is delivered. The first €100 could be deposited at a fixed rate and be assured that the rate quoted at inception would be the rate for the term of the deposit, whether it be one month or three.
Continuing this analogy, €100 is duly deposited today at the rate of 4.54% for three months. The author is happy, although a bit concerned about newspaper reports suggesting lower UK interest rates in the future. He is increasingly concerned that in nine months’ time, deposit rates may not be as high as they are today. Since he will not receive the other £100 for nine months, the deposits market is not applicable and he really wants to lock in an interest rate for, say, three months that starts, not today as in the case of deposits, but in nine months’ time – which introduces the forwards market.

Forwards market

The forwards market is concerned with forward-starting interest rates. These are contracts where a deposit or borrowing rate is determined today for a deposit or borrowing starting on some predefined date in the future for a specified period.

The author is then faced with the problem of determining the three-month interest rate starting in nine-months’ time. The diagram below shows that the nine-month rate is 4.62% and the 12-month rate is 4.66%, so it’s just a question of working out the value of the missing three-month period between nine and 12 months. This can be viewed diagrammatically as:

```
12 months (4.66%)

9 months (4.62%) 3 months forward rate ??
```

Timeline      Today  9 months   12 months

It is possible to mathematically solve for the ‘missing’ three-month period between 12 months and nine months by working through the cash flows if €100 were deposited in two different ways.

1. Since the 12-month rate is known to be 4.66%, funds could be deposited for that period at that rate. Depositing €100 for 12 months at 4.66% would provide €4.725 interest at maturity ($€100 \times 4.66\% \times 365/360$) (using a European money market date convention of Act/360 and assuming 365 days in the year).
2. A similar sum could also be deposited for nine months starting from now until nine months hence at the rate of 4.62%. Depositing €100 for nine months at 4.62% will give €3.465 (€100 x 4.62% x 270/360) (assuming nine months is 270 days).

What needs to be done now is to solve for the rate at which the nine-month deposit could be reinvested for a further three months so that the total of interest received from both nine-month and three-month deposits is the same as that of the single 12-month deposit. This rate will be the nine-month forward rate.

Working this through gives the following cash flows:

- The nine-month deposit needs an additional €1.26 (€4.725 - €3.465) to be earned by reinvesting the nine-month deposit for a further three months so that this method equals the amount that could have been made by just investing in the 12-month deposit.
- However, the original €100 is now worth €103.465 after nine months and so this is reinvested for a further three months. This concept of earning interest on the interest is called compound interest. The rate at which it is reinvested for the €103.45 to generate €1.26 in interest is then calculated by:

\[ \frac{€1.26}{(€103.465 \times 90/360)} = 4.87\% \] (assuming 90 days in the three-month period) and this is the forward rate for three months, starting in nine months’ time.

This concept can be expressed mathematically as a closed form formula using the relative of discount factors. These are effectively the present value of €1 at time $t$.

For example, if 9M EURIBOR is 5%, then the value today of €1 in nine months’ time can be calculated as:

\[
\frac{1}{1 + (5\% \times \text{Act}/360)}
\]

This would be the nine-month discount factor and if the 12-month discount factor were known, the three-month forward rate starting in nine months’ time could be calculated by:

\[
\text{Forward Rate}_{m, m+1} = \frac{\left( \frac{Df_m}{Df_{m+1}} - 1 \right)}{\text{AccrualFactor}_{m,m+1}}
\]
Where $D_f$ is the discount factor either at the start or end of the forward period and the accrual factor is the proportion of the year which the forward rate covers ($t_n$ to $t_{n+1}$), incorporating the correct year base convention (360 days in the case of the euro and USD and 365 days for GBP).

Populating this equation with the numbers from the above example gives:

$$
\begin{array}{c}
\frac{1}{1+4.62\% \times \frac{270}{360}} - 1 \\
\frac{1}{1+4.66\% \times \frac{365}{360}} \\
\frac{90}{360}
\end{array} = 4.87\%
$$

This allows for the easy calculation of forward rates by use of a spreadsheet, omitting the need to work out individual cash flows each time, and gives the same answer as the manually calculated example using the cash flows. 4.87% is the forward rate that could be expected based upon the given deposit rates and this is the rate, fixed today, at which the author could expect to place €100, receivable in nine months’ time, on deposit for three months.

In theory, there needs to be no advantage in depositing in either a single 12-month deposit or by investing in a nine-month deposit rate and a nine-month forward for three months. However, in reality the market forward rate is always a little less than its theoretical rate since the market attaches risk to progressively longer-term fully-funded unsecured deposits.

Forward rates are very dependent on the shape of the spot yield curve. If the yield curve is positively sloped, then forward rates will be higher than spot rates. Conversely, in a negatively sloped curve, forward rates will be lower than spot. This means that a derivative based upon forward rates like a Euribor or Eurodollar future might appear to be predicting higher or lower rates in the future but not necessarily so. The forward curve is a mathematical equilibrium that has to hold a particular relationship to the spot yield curve and doesn’t necessarily contain any information about the market’s future expectations of interest rates.
STIR Futures Valuation

Basic pricing concepts

STIR futures:

*confer the borrowing or lending at a rate determined by the price at which the future was transacted, for a period of three months after the expiry and settlement of the contract.*

This is the same concept as the forward rate except that the STIR future is a derivative and so its traded price will *imply* a forward rate.

Implied forward rates from STIR futures can be calculated as:

\[ 100\% - \text{STIR futures market price}\% \]

The value basis

Value basis is the difference between an equivalent term LIBOR or EURIBOR derived forward rate and the implied forward rate from a STIR future:

\[ \text{Equivalent term LIBOR/EURIBOR derived forward rate} - \text{STIR futures implied forward rate} \]

The value basis is a measurement of the implied forward rate of the STIR futures contract relative to the equivalent term forward rate.

Using the previous forward pricing example, the three-month forward rate starting in nine months’ time was found to be 4.87%. If the actual market price of an equivalent term STIR future was 95.15 (giving an implied forward rate of 4.85%), then the value basis would be 0.02% (4.87% - 4.85%). This could be interpreted as the STIR futures trading *expensively* in price terms (95.15 versus 95.13) or *cheaply* in rates terms (4.85% versus 4.87%).

Valuing Euribor futures

Valuing STIR futures is complex, incorporating several concepts that are cornerstones of financial modelling but complicated in theory and application. However, it is not essential to the understanding or application of STIR futures. Readers can skip it if they prefer.
The following sections depict how traditional STIR futures valuations models work. The process is contained within Bloomberg Professional, specifically the EUS <GO> page for the Euribor contract.

So far, two discount factors have been calculated (nine-month and 12-month discount factors) and used to calculate a three-month forward rate starting in nine months' time and then compared to the implied forward rate of an equivalent-term STIR future.

This process needs to be accurately replicated for all the required futures expiry dates. This will allow the comparison of the sequential forward rates with the implied forward rates from the STIR futures.

The process is as follows:

1. Determine a discount curve. This is a plot of discount factors of various maturities.
2. Interpolate the discount factors to match the futures dates.
3. Compare the forward rates with the implied forward rates from the STIR futures and identify any areas on the futures strip that might be considered under- or over-valued.

The discount curve

The discount curve needs to be calculated from spot rates on AA-rated securities in the currency of the relevant STIR future.

In the case of the Euribor STIR future, this would comprise EURIBOR fixings (or more specifically EURIBOR depo rates since EURIBOR is a survey-based fixing not an actual borrowing rate) and euro swaps. A swap is an interest rate derivative that replicates a fixed borrowing or lending at a weighted average of forward EURIBOR rates. It is a very liquid market, representative of the interbank AA credit curve (as determined by credit rating agencies like Standard & Poor's or Fitch).

Euribor rates are quoted in maturities from overnight to 12 months and euro swaps are quoted from one year to 50 years.
Discount factors from deposit rates can be calculated from:

\[
Df_{\text{deposit}} = \frac{1}{1 + EURIBOR \times AccrualFactor}
\]

Where EURIBOR is the relevant term Euribor rate and the accrual factor is the year fraction incorporating the correct day count convention – in the case of Euribor, this would be Act/360.

Extracting discount factors from swap rates is more complicated but the standard industry methodology is:

\[
DF_n = \frac{1 - \text{Swap}_n \times \sum_{t=1}^{n-1} DF_t \times A_t}{1 + \text{Swap}_n \times A_n}
\]

Where Swap$_n$ is the relevant term swap rate and

\[
\sum_{t=1}^{n-1} DF_t \times A_t
\]

this is the sum of the preceding discount factors (DF) times the accrual factor (A) at time $t$.

It is beyond the scope of this book to derive this formula but a good book or course on swaps pricing should make this standard process clearer. What this formula does do is extend the discount curve beyond the 12-month limitation of EURIBOR rates by incorporating swap rates until a discount curve is produced covering a range of maturities.
Table 1.9 – Euro AA-rated discount curve on 28 October 2011 for value 1 November using EURIBOR rates for spot/next, one, three and six-month and swaps for one year onwards

<table>
<thead>
<tr>
<th>Trade date</th>
<th>28-Oct-11 Fri</th>
<th>Spot Value</th>
<th>2</th>
<th>Spot date</th>
<th>1-Nov-11 Tue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depos &amp; Swap term</td>
<td>Dates</td>
<td>Rates (%)</td>
<td>A/360</td>
<td>30/360</td>
<td>Discount Factors (DF)</td>
</tr>
<tr>
<td>SN</td>
<td>2-Nov-11 Wed</td>
<td>1.1360</td>
<td>0.0028</td>
<td>0.0028</td>
<td>0.999968</td>
</tr>
<tr>
<td>1M</td>
<td>1-Dec-11 Thu</td>
<td>1.3660</td>
<td>0.0833</td>
<td>0.0833</td>
<td>0.998863</td>
</tr>
<tr>
<td>3M</td>
<td>1-Feb-12 Wed</td>
<td>1.5920</td>
<td>0.2556</td>
<td>0.2500</td>
<td>0.995948</td>
</tr>
<tr>
<td>6M</td>
<td>1-May-12 Tue</td>
<td>1.7930</td>
<td>0.5056</td>
<td>0.5000</td>
<td>0.991017</td>
</tr>
<tr>
<td>1Y</td>
<td>1-Nov-12 Thu</td>
<td>1.6700</td>
<td>1.0000</td>
<td>0.983574</td>
<td></td>
</tr>
<tr>
<td>2Y</td>
<td>1-Nov-13 Fri</td>
<td>1.5650</td>
<td>1.0000</td>
<td>0.969435</td>
<td></td>
</tr>
<tr>
<td>3Y</td>
<td>3-Nov-14 Mon</td>
<td>1.7300</td>
<td>1.0056</td>
<td>0.949692</td>
<td></td>
</tr>
<tr>
<td>4Y</td>
<td>2-Nov-15 Mon</td>
<td>1.8800</td>
<td>0.9972</td>
<td>0.927933</td>
<td></td>
</tr>
<tr>
<td>5Y</td>
<td>1-Nov-16 Tue</td>
<td>2.0560</td>
<td>0.9972</td>
<td>0.902679</td>
<td></td>
</tr>
<tr>
<td>6Y</td>
<td>1-Nov-17 Wed</td>
<td>2.2800</td>
<td>1.0000</td>
<td>0.872190</td>
<td></td>
</tr>
<tr>
<td>7Y</td>
<td>1-Nov-18 Thu</td>
<td>2.3900</td>
<td>1.0000</td>
<td>0.845809</td>
<td></td>
</tr>
<tr>
<td>8Y</td>
<td>1-Nov-19 Fri</td>
<td>2.5000</td>
<td>1.0000</td>
<td>0.818256</td>
<td></td>
</tr>
<tr>
<td>9Y</td>
<td>2-Nov-20 Mon</td>
<td>2.6200</td>
<td>1.0028</td>
<td>0.788808</td>
<td></td>
</tr>
<tr>
<td>10Y</td>
<td>1-Nov-21 Mon</td>
<td>2.6800</td>
<td>0.9972</td>
<td>0.763565</td>
<td></td>
</tr>
</tbody>
</table>

Interpolating discount factors to match the futures dates

Once the discount curve has been produced, the discount factors need to be interpolated to match the futures expiry dates.

Interpolation is the method of constructing new data points within the range of a discrete set of known data points. The known data points are the discount factors derived from EURIBOR and swap rates and the new data points are the futures expiry dates and the superseding three-month period.

There are various interpolation methods available including:

- linear interpolation of discount factors
- linear interpolation of the logs of the discount factors
- cubic spline interpolation on the zero yield curve or discount functions

Generally the second and third methods give more consistent results but are more complex to implement.
Table 1.10 – Implied forwards from futures and theoretical forwards derived from linear interpolation of the logs of the discount factors from EURIBOR rates and swaps

<table>
<thead>
<tr>
<th>Dates</th>
<th>Futures</th>
<th>Futures</th>
<th>100-F (convexity adjusted)</th>
<th>Interpolated discount factors</th>
<th>Implied forwards from futures</th>
<th>Theoretical forwards</th>
</tr>
</thead>
<tbody>
<tr>
<td>3W Euribor</td>
<td></td>
<td></td>
<td>1.297%</td>
<td>1.00000</td>
<td>1.297%</td>
<td>1.297%</td>
</tr>
<tr>
<td>21-Nov-11 Mon</td>
<td>X1</td>
<td>98.465</td>
<td>1.535%</td>
<td>0.99928</td>
<td>1.535%</td>
<td>1.362%</td>
</tr>
<tr>
<td>19-Dec-11 Mon</td>
<td>Z1</td>
<td>98.600</td>
<td>1.400%</td>
<td>0.99809</td>
<td>1.400%</td>
<td>1.582%</td>
</tr>
<tr>
<td>19-Mar-12 Mon</td>
<td>H2</td>
<td>98.785</td>
<td>1.213%</td>
<td>0.99461</td>
<td>1.213%</td>
<td>1.850%</td>
</tr>
<tr>
<td>18-Jun-12 Mon</td>
<td>M2</td>
<td>98.835</td>
<td>1.161%</td>
<td>0.99160</td>
<td>1.161%</td>
<td>1.726%</td>
</tr>
<tr>
<td>17-Sep-12 Mon</td>
<td>U2</td>
<td>98.825</td>
<td>1.169%</td>
<td>0.98873</td>
<td>1.169%</td>
<td>1.490%</td>
</tr>
<tr>
<td>17-Dec-12 Mon</td>
<td>Z2</td>
<td>98.770</td>
<td>1.221%</td>
<td>0.98585</td>
<td>1.221%</td>
<td>1.457%</td>
</tr>
<tr>
<td>18-Mar-13 Mon</td>
<td>H3</td>
<td>98.695</td>
<td>1.292%</td>
<td>0.98285</td>
<td>1.292%</td>
<td>1.424%</td>
</tr>
<tr>
<td>17-Jun-13 Mon</td>
<td>M3</td>
<td>98.595</td>
<td>1.388%</td>
<td>0.97968</td>
<td>1.388%</td>
<td>1.424%</td>
</tr>
<tr>
<td>16-Sep-13 Mon</td>
<td>U3</td>
<td>98.495</td>
<td>1.483%</td>
<td>0.97630</td>
<td>1.483%</td>
<td>1.424%</td>
</tr>
<tr>
<td>16-Dec-13 Mon</td>
<td>Z3</td>
<td>98.355</td>
<td>1.618%</td>
<td>0.97269</td>
<td>1.618%</td>
<td>1.721%</td>
</tr>
<tr>
<td>17-Mar-14 Mon</td>
<td>H4</td>
<td>98.225</td>
<td>1.742%</td>
<td>0.96877</td>
<td>1.742%</td>
<td>2.024%</td>
</tr>
<tr>
<td>16-Jun-14 Mon</td>
<td>M4</td>
<td>98.070</td>
<td>1.891%</td>
<td>0.96457</td>
<td>1.891%</td>
<td>2.024%</td>
</tr>
<tr>
<td>15-Sep-14 Mon</td>
<td>U4</td>
<td>97.905</td>
<td>2.049%</td>
<td>0.96003</td>
<td>2.049%</td>
<td>2.024%</td>
</tr>
</tbody>
</table>

Table 1.10 shows the futures expiry dates for the November 2011 (X1) contract out until the September 2014 contract (U4). The implied forward rate from the futures is derived from $100 - \text{Price (convexity adjusted)}$ – see subsequent pages and the theoretical forward rates derived from interpolated discount factors from EURIBOR rates and swap rates using:

$$\text{Forward Rate}_{tn,tn+1} = \frac{\left( \frac{Df_{tn}}{Df_{tn+1}} - 1 \right)}{\text{Accrual Factor}_{tn,tn+1}}$$

Where $Df$ is the discount factor either at the start or end of the forward period and the accrual factor is the proportion of the year which the forward rate covers ($t_n$ to $t_{n+1}$), incorporating the correct year base (360 days in the case of the euro).

Implied forward rates from futures versus theoretical forward rates

The last two columns of the table show the implied forward rates from the STIR futures and the theoretical forwards derived from the discount curve based on
EURIBOR and swap rates. These forwards from discount factors are theoretical since they are not market quotes.

Graphing these shows the disparity between them. The difference between them is the value basis.

Clearly there is not much of a link between them. And yet there should be. Both are supposedly the same thing; namely a three-month forward rate starting at specified time in the future. The value basis is the difference between these two curves and is wide with no discernible pattern.

Drivers of the value basis

What is being observed here is a dislocation between the forwards derived from EURIBOR rates and the implied forwards from the STIR futures based upon them.

Prior to the financial crisis of 2007/8 the forward curve and implied forward curve from the futures were almost identical, with arbitrage being cited as the prime reason why these two curves should not diverge.

However, all this changed in the financial crisis. The effects remain today. From 2007, interbank lending linked to EURIBOR and LIBOR rates largely dried up and counterparty risk was transformed from a relatively minor and unlikely risk into a
major risk. Banks that had traditionally partially funded themselves by borrowing via interbank transactions found that counterparty banks no longer wanted to lend, since interbank transactions are fully funded but unsecured. A default by the borrower could have serious ramifications.

Central banks responded to this drying up of interbank liquidity by offering unlimited overnight money and term repo transactions (secured lending) to banks, meaning they no longer had to rely on the interbank markets for funding. This led to a collapse of volume and business in interbank markets, meaning that EURIBOR and LIBOR quotes (and therefore EURIBOR and LIBOR-derived forward quotes) were largely arbitrary.

However, STIR futures, being derivatives, continued to actively trade – and paradoxically became a market proxy for the three-month forward curve, even though it was a derivative on a market that had largely ceased to function.

The two forward curves in the chart now show a value basis reflecting the risk between a EURIBOR forward curve effectively constructed from cash borrowings and lendings that carry multiple hazards of counterparty risk, funding risk and term risk (see following sections) compared to the forward curve from futures containing none of these hazards.

Advanced pricing concepts

Convexity and the convexity bias

Changes in the prices of STIR futures like Eurodollars and Euribor futures are driven by changes in the underlying interest rates. STIR futures trade at a fixed basis point value ($25 or €25) irrespective of the level of interest rates and therefore their price sensitivity to a change in rates is linear and has no convexity.

For example: A change in interest rates from 5% to 5.01% would imply a change in STIR future value from 95.00 to 94.99, which on one contract such as the Euribor would be worth €25. This would be the same if interest rates changed from 2% to 2.01%, therefore showing that the basis point value does not change relative to the level of interest rates.

STIR futures are often used to hedge instruments like bonds and interest rates swaps (see later chapters). Bonds and swaps do not have fixed basis point values as underlying rates change and therefore exhibit convexity in their price/rate relationship. Generally, the value of a basis point on a bond or swap diminishes as rates increase and increases as rates fall.
This means there can be an inherent advantage in receiving the fixed rate on an interest rate swap, which is a convex instrument, and hedging the interest rate risk by being short STIR futures with no convexity.

Receiving the fixed rate on a swap is like lending via a sequential series of LIBOR or EURIBOR-linked forward rates, and this could be hedged by being short STIR futures (a notional borrowing).

- As interest rates increase, the basis point value of the swap will decrease whereas the STIR future basis point value will remain constant, leading to a small potential profit on the hedge. Being short STIR futures in a rising interest rate environment will make a trader money and receiving fixed on an interest rate swap in a falling interest rate environment will lose a trader money but at a diminishing rate.

- As interest rates fall, the basis point value of the swap will increase, whereas the STIR future basis point value will remain constant, leading to a small potential profit on the hedge. Being short STIR futures in a falling interest rate environment will lose money and receiving fixed on an interest rate swap in a falling interest rate environment will make money at an increasing rate.

However, the situation is made more complex due to the different settlement procedures between STIR futures and swaps.

Futures are settled daily and their profit or loss added or subtracted to or from the margin account, whereas the floating side of a swap settles only on the swap’s setting dates.

- If interest rates increase, the futures price will fall, leading to a profit on the short STIR futures position and a margin credit that can be reinvested at higher rates.

- If interest rates fall, the futures price will increase, leading to a loss on the short STIR futures position and a margin deficit; but this can be financed at the lower rates.

The advantages in being short STIR futures against receiving fixed swaps result in the markets quoting implied forward rates from STIR futures at higher rates (making the STIR futures price lower) than they would otherwise be. This effect is termed the convexity bias.

There are several methods of calculating the convexity bias, most of which are complex, and readers with further interest are directed to the recommended reading below. Convexity bias generally increases with term and is driven by volatility and mean reversion of interest rates.

1 ‘Convexity Conundrums’, Risk (March 1997), www.powerfinance.com/convexity
The pricing example in Table 1.10 has a convexity bias for the Euribor U4 futures of 4.6 basis points.

The markets are well aware of the convexity bias and therefore the implied forward rate of the U4 future has to be adjusted. 4.6 basis points is deducted from the forward rate implied by the future to obtain an unbiased implied forward rate. The Euribor U4 was trading at 97.905, implying a forward rate of 2.095%, which is reduced to a convexity-adjusted 2.045%.

**Another method: stringing/chaining**

Comparing forward rates derived from a discount curve to the equivalent implied forward rates from STIR futures can be problematic due to the sensitivity of the forward curve in relation to changes in the discount curve and interpolation methodologies.

An alternative valuation methodology is stringing or chaining. Here, a zero coupon yield is determined for a particular maturity derived from a discount curve based on deposit rates and swaps and compared to an equivalent term strip of futures linked (hence ‘stringed’ or ‘chained’) together to match the maturity.

The diagram shows two timelines:

**Fig. 1.6 – Stringing/chaining**

<table>
<thead>
<tr>
<th>Zero rate from discount factors a one-year swap</th>
<th>2.564%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today</td>
<td></td>
</tr>
<tr>
<td>6-months</td>
<td></td>
</tr>
<tr>
<td>12-months</td>
<td></td>
</tr>
<tr>
<td>Z1</td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td></td>
</tr>
<tr>
<td>U2</td>
<td></td>
</tr>
</tbody>
</table>

| Zero rate from strip of four compounded STIR futures (one-year) | 2.167% |

The top timeline is a one-year swap expressed as a zero rate (for example, 2.564%) and the bottom timeline is a strip of four STIR futures linked together to give a zero rate (for example, 2.167%). Comparison of the two zero rates can identify cheap or expensive parts of the strip (in this case, the futures strip appears cheap in rate terms compared to the swaps).
A zero rate is essentially the yield to maturity on a zero coupon bond which is devoid of reinvestment risk. Reinvestment risk is a feature of any asset like a swap that throws off intermediate cash flows that have to be reinvested at the original return. Otherwise the total return if held to maturity can be distorted. Zero rates are considered pure and homogenous interest rates ideal for financial modelling.

Zero rates can be backed out of discount factors derived from deposits and swaps by:

\[
Z_n = \left( \frac{1}{DF_t} \right)^{1/\sum_{t=1}^{n-1} t_i} - 1
\]

Where \( Z_n \) is the \( n \) term zero rate, DF is the discount factor at time \( t \) and

\[
\sum_{i=1}^{n-1} t_i
\]

is the sum of the accrual factors to time \( t \).

For example, the zero rate from a one-year swap with a discount factor of 0.975 where \( t = 1 \) would be:

\[
(1/0.975)^{1/1} - 1 = 2.564\%
\]

The STIR futures can be linked together to form a zero rate by:

\[
[(1 + IFR_1 \times \text{accrual}) \times (1 + IFR_2 \times \text{accrual}) \times (1 + IFR_3 \times \text{accrual}) \times \ldots \times (1 + IFR_n \times \text{accrual})] - 1
\]

Where IFR is the implied forward rate from the futures (100% - Price%) and the accrual is the year fraction covered by the future (0.25).

For example, using the following prices:

<table>
<thead>
<tr>
<th>Table 1.11 – Example prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market price (P)</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Z1</td>
</tr>
<tr>
<td>H2</td>
</tr>
<tr>
<td>M2</td>
</tr>
<tr>
<td>U2</td>
</tr>
</tbody>
</table>
And stringing the futures together …

\[(I + 2.0\% \times 0.25) \times (I + 2.1\% \times 0.25) \times (I + 2.2\% \times 0.25) \times (I + 2.3\% \times 0.25) - 1 = 2.167\%\]

In this simplified case, the zero rate from the futures strip at the one-year term appears cheap and undervalued compared to the zero rate from the one-year swap. It is effectively saying that if €1 were invested in the swap, there would be a return after one year of 2.564%, but if the same €1 were invested in a quarterly compounded strip of four STIR futures, the return would only be 2.167%.

This process, refined for market accrual conventions, start dates and futures expiries can be extended along the entire futures strip and the results viewed graphically as a term structure of zero rates between swaps and futures. Using the data for the previous study on Euribor futures on 1 November 2011, the cash and futures strings appear as in the graph.

Fig. 1.7 – Cash string (chains) from swaps compared to futures strings – Euribor futures 1 November 2011

The graph shows a similar pattern to the prior graph of Euribor futures implied forward rates versus theoretical forward rates on 1 November 2011. This methodology gives smoother results but a basis is still evident with a difference of approximately 0.25% at the two-year point, which is due to term risk.
Term risk (tenor basis)

At first sight this appears to be an arbitrage opportunity – for example, the opportunity to enter into a two-year swap to receive a higher rate than what would be paid out by stringing together a strip of equivalent-term STIR futures. However, the word arbitrage denotes a risk-free profit – but in this case a trader attempting to monetarise this difference is taking on a hidden risk which accounts for the 0.25% difference.

The trade would be constructed by first receiving the fixed rate on the two-year euro swap. A swap denominated in euros is a bilateral derivative made up of two sides: one side is the exchange of an annual fixed rate of interest in return for the other side, which is a semi-annual floating rate of interest based on six-month EURIBOR. The trader would elect to enter into the swap transaction as the fixed rate receiver, meaning that they have an obligation to lend out the semi-annual floating payments based on six-month EURIBOR. The fixed rate received on the swap at inception would actually be the weighted average of these six-month EURIBOR forward rates being paid out. Secondly, the trader would borrow every three months for two years at three-month EURIBOR, with forward rates locked in by constructing a two-year strip of Euribor futures from individual contracts strung together.

The hidden risk here that accounts for the 0.25% difference between receiving the higher rate on the swap and borrowing at the lower rate in the Euribor strip is due to term risk. Remember that EURIBOR is an unsecured rate and consequently a credit premium exists for term lending versus rolling funding in shorter intervals. A trader that rolls three-month borrowings for three months has the option to cancel every three months, whereas a trader who lends for a six-month term does not. The difference of 0.25% is the credit premium demanded by the markets to reflect the credit and liquidity perceptions between three- and six-month EURIBOR in November 2011.

This risk can be hedged out by use of another derivative – a basis swap. A EURIBOR/EURIBOR basis swap is a floating-for-floating exchange of (netted) cash flows, where each floating side references a distinct EURIBOR fixing – in this case three- and six-month EURIBOR rates. Basis swaps are quoted as a spread against the shorter underlying tenor and the payment is determined by the longer tenor. For example, the 6s3s (sixes into threes) EURIBOR/EURIBOR basis swap is quoted as the three-month EURIBOR + spread with the payment frequency being six-monthly (with the three-month side being compounded). In November 2011, the 6s3s EURIBOR basis swaps were unsurprisingly trading around 0.25%, thus negating any scope for profit if a true risk-free arbitrage was required.
It should be noted that this example has been simplified to highlight the concept of term risk and has not touched upon other issues like the fact that a swap transaction would start almost immediately, whereas the STIR strip is forward starting. This issue and others will be explored later.

In conclusion, STIR futures pricing has evolved through the financial crisis from what was formerly a fairly simple comparison between forward rates derived from LIBOR and EURIBOR rates and the implied forward rates from STIR futures, to a complex methodology which draws in relative value comparisons and adjustments using other complex derivatives. Traders should try to be aware of these new influences on STIR pricing.

Hedging with STIR futures

Hedging is where an existing financial risk is offset by taking an opposite position in another instrument or market.

For example, a company might have an existing borrowing requirement and they hedge by selling interest-rate futures contracts.

If interest rates rise, the higher borrowing cost will be offset by profits on the futures position. However, a futures hedge will offset both losses and gains and in the example above, if interest rates fall, the lower borrowing cost will also be offset, this time by losses on the futures position.

A simple hedging example

It is March and a European Hotel Group has agreed to acquire a German hotel for €25m in June. The company plans to issue permanent capital to finance the purchase three months later in September. The treasurer has established a EURIBOR flat line of credit to finance the gap from June until September but fears that interest rates may rise between now and June.

The treasurer could sell 25 Euribor June futures at 97.00, implying a borrowing rate of 3% starting from the expiry of the June future (which is assumed to be the same as the start of the three-month borrowing period) for 0.25 years.
Fast-forward to June and the treasurer’s fears have been confirmed. The three-month EURIBOR rate has risen to 3.25%, leading to higher three-month borrowing costs. The expiring futures on the same day as the borrowing starting would have an EDSP of 96.75 (100 - 3.25) which would result in a profit of €15,625.

\[25 \text{ contracts} \times €25 \text{ (BPV)} \times 25 \text{ basis points} = €15,625\]

The cost of borrowing €25 million for three months (say 90 days) would be €203,125:

\[25,000,000 \times 3.25\% \times 90/360 = €203,125\]

Meaning that the net borrowing cost was only €187,500 (203,125 - 15,625). This amount expressed relative to the amount borrowed results in a net annualised borrowing rate of 3%, exactly the same as implied by the futures price of 97.00 when sold in March.

\[187,500/25,000,000 \times 360/90 = 3\%\]

**Hedging considerations**

This hedging transaction worked perfectly for a variety of reasons, all to do with the hedge requirements being met perfectly by the standard features of the STIR future, notably:
Principal at risk

- 25 futures exactly matched the borrowing exposure of €25 million.

Exposure period

- The borrowing period of 90 days in a 360-day year was exactly the same year fraction as that of the futures contract.
- The start and end of the borrowing period coincided with the futures expiry dates.
- Zero basis risk as convergence between cash and futures was complete.

Exposure basis

- The company was borrowing at a EURIBOR-linked rate and there was no basis risk on the relationship between the borrowing rate and EURIBOR.

Margin flows

- The futures profit or loss is always received or paid before the loss or profit on the underlying borrowing.
- If any of these conditions do not apply the hedge will not be as perfect.

A more complex hedge...

Consider a more complex but realistic hedging variation on the above example …

It is March and a hotel group has agreed to acquire a German hotel for €25m in mid-May. The Company plans to issue permanent capital to finance the purchase two months later in July. The Treasurer has established a credit line linked to two-month commercial paper rates to finance the gap from May until July but fears that interest rates may rise between now and May.

In this situation, using a June Euribor future would introduce basis risk if the June futures price was not exactly the same as three-month EURIBOR on the borrowing date in May. The June futures would have to be sold in mid-May, which is about one month before the futures expiry date, and there is no reason for the futures price to have converged to the three-month EURIBOR rate by then. Any difference between the implied rate from the future and the actual borrowing rate will affect the overall effective borrowing rate on the hedge.
Furthermore, 25 contracts would not be applicable since the treasurer only wants to borrow €25 million for two months, not three, and the company is borrowing at a rate linked to commercial paper rates not EURIBOR rates.

Solution

This is an example of where STIR serial futures are applicable. A May future could be used instead, and even though the expiry day of the future might not be exactly the same as the borrowing day in mid-May, the implied rate from the future would be very close to the three-month EURIBOR rate.

However, the treasurer is not borrowing at three-month EURIBOR but a two-month commercial paper rate, so a regression analysis would be necessary to quantify how one rate changes in relation the other, resulting in a Beta statistic, assumed here to be 1.05, meaning that if EURIBOR rates increase by one basis point, then two-month commercial paper rates would increase by 1.05 basis points.

Also, only a two-month borrowing period is required, so the sensitivity of the borrowing to a basis point change in rates (BPV or basis point value) is required. Assuming that the two-month borrowing period is 62 days, then the BPV of the borrowing would be:

\[ \varepsilon 25,000,000 \times 0.01\% \times \frac{62}{360} = \varepsilon 430.56 \]

Dividing this BPV by the BPV of the May future (€25) returns 17.22 (430.56/25) and this is the approximate number of May futures that should be sold. Approximate because two-month commercial paper rates might be assumed to be more volatile than EURIBOR rates as shown by the Beta of 1.05 and therefore the hedge should be increased accordingly.

\[ 17.22 \times 1.05 = 18.08 \]

There is also the comparatively minor issue of tailing the hedge.

Variation margin flows occur on the futures during the operation of the hedge and interest can be earned or paid on these flows, depending on whether these flows are positive or negative. In contrast, interest on the actual borrowing is only settled at the end of the borrowing/lending period. The effect of margin flow interest will increase the magnitude of the flows and so the hedge must be scaled down by applying a variation margin leverage factor such as:
Where \( i \) is the short term interest rate, \( B \) is the number of days per year, \( D_h \) is the length of the hedging period and \( D_b \) is the length of the borrowing period.

In this case, using a short rate of 3\% with the hedging period being from March to mid-May, (say 60 days) and the borrowing period being 62 days, the variation margin leverage factor is 0.9924.

\[
\frac{1}{1 + \frac{i}{\frac{D_h + D_b}{B}}} = 0.9924
\]

and the hedge ratio should be reduced accordingly to compensate for the margin flows benefits.

\[18.08 \times 0.9924 = 17.94\]

Of course, it is not possible to sell 17.94 May futures but the tailing hedge and Beta factors can be useful in deciding to round up or down. In this case 18 May futures should be sold.

Populating the example

March: In March, three-month EURIBOR was observed to be 3\% and two-month commercial paper rates were 3.13\%. 18 May futures were sold to hedge the borrowing exposure of €25 million for 62 days starting in mid-May.

Mid-May: By mid-May interest rates had increased as feared. Three-month EURIBOR is now 3.25\% and two-month commercial paper has increased to 3.39\% (hence a beta of 1.05). The futures are repurchased at 96.74. This is not quite the same as 100 - 3.25 since an assumption is made that the borrowing date and futures expiry date is not quite the same and so there is a small basis. This would result in a profit of:

\[18 \text{ contracts} \times \text{€}25 \times 26 \text{ basis point} = \text{€}11,700\]
This would be sat in the margin account accruing interest whilst the cash borrowing of €25 million at 3.39% for 62 days would result in interest due of €145,958.

\[ \text{\( \text{\euro}25,000,000 \times 3.39\% \times \frac{62}{360} = \text{\euro}145,958 \)} \]

The net borrowing cost was €134,258 (145,958 - 11,700).

This amount expressed relative to the amount borrowed results in a net annualised borrowing rate of 3.12%:

\[ \frac{134,258}{25,000,000} \times \frac{360}{62} = 3.12\% \]

This is very close to the two-month commercial paper rate in March of 3.13%, which the treasurer via the hedge was trying to lock in. It is not perfect due to the basis between the price that the futures were bought back at (96.74) and the three-month EURIBOR rate on that day (3.25%). In this case the futures were implying a EURIBOR rate of 3.26%, which gave an improvement of one basis point on the effective borrowing rate on two-month commercial paper.

Basis can affect the effective borrowing rate when the futures have to be repurchased to close before their expiry. If the basis is wide it can either improve the effective borrowing rate by making it lower or increase it by making it higher.
In reality, the basis within the final month to expiry is usually +/-10 basis points, decreasing toward zero in the final week. Provided a STIR future with an expiry date within two weeks of the borrowing date is used, then basis risk can be contained within an acceptable tolerance. However, other factors like whether the beta between three-month EURIBOR and two-month commercial paper calculated from a backwards-looking data sample was actually representative of the borrowing period can be an additional influence on the accuracy of the hedge.

When hedging non-standard exposures with standardised instruments like STIR futures, hedging can be more of an art form than a science!

Fig. 1.10 – Basis between September 2011 futures and three-month EURIBOR June 2011 to September 19 2011 (basis RH axis)
The Drivers of STIR Futures Prices

There are two broad categories of drivers behind the prices (and change in the prices) of STIR futures: changes in the futures curve and price-sensitive effects.

The changing shape of the futures curve

STIR futures are implied forward rates and sequential strips of STIR futures are representative of a three-month forward curve based on derivatives. These sequential STIR futures prices can contain market expectations of future interests.

The curve is constantly changing

Although it has been said earlier that curves tend to be positively sloping, that is, longer-dated rates tend to be higher than nearer dated rates, the curve can take many shapes. In times of falling interest rates, all or part of the curve might be negatively sloping, where the longer-dated rates are lower than the near-dated ones. Curves can move sharply from one shape to another as illustrated by the chart that shows data from 2006–2008.

Fig. 1.11 – Euribor implied forward curve (100% - Price%) 2006–2008
The October 2006 curve shows the implied forward curve from Euribor futures starting Z8 until U10 and the curve is slightly positive with no great expectations built in.

Fast-forward two years to September 2008 and the Lehman crisis. Expectations of future interest rate cuts produce a negatively shaped curve. This effect is magnified by December 2008 when a rapidly slowing global economy increases expectations of even lower rates, resulting in a curve which is partly steeply negative and partly positive. Here the futures curve is suggesting that rate cuts will bottom in the eurozone around 2.30% during early 2009 before moving back up later in the year or early 2010. History proved that rates were to move lower (1%) and stay there for a considerable period.

However, futures curves are normally not static for long. New data and forecasts, right or wrong, constantly influence the outlook for rates and hence the STIR futures price curve. The yield curve will always be a melting pot of opinion and expectations, ensuring that STIR futures will be active products to trade!

Liquidity considerations of the micro-curve

The micro-curve can be considered to be the local effects on a small segment of the curve. STIR futures are generally liquid to around three to five years but differing levels of liquidity along with market expectations can give rise to small distortions. These distortions can create opportunities in certain trades such as spreads and strategies.

These distortions are based upon the concept of liquidity preference. Users of STIR futures often tend to trade the front, white months, which reflect about a year's interest rate expectations. Consequently these months or contracts tend to have the highest traded volume and be the most liquid markets, in turn attracting new trade for precisely that reason.

The following table shows the Eurodollar data from the close of business on 8 December 2011. The data includes the contract, settlement (closing) price, net change from the previous day’s settlement price, total traded volume and open interest (number of open contracts).
The Eurodollar shows how H2 and M2 have the highest volume and open interest and are the main points of liquidity on the STIR price curve – not the front month Z1 that is close to expiry (note how the December contract trades in quarter basis points in line with its contract specifications and how only the first serial month has any volume or open interest). Volumes steadily decline from these points onwards until around the 2018 contracts, where volumes are very low but there is tangible open interest. Arguably, a trader wishing to execute a large order would be more inclined towards trading H2 to Z3 contracts simply because the market is more able to accommodate the business.

The net change shows a general curve flattening where longer-dated rates have declined more than shorter-dated rates (longer-dated futures have gone up more in price than shorter-dated futures). Often, the back months might be higher or lower than the front, reflecting changing curve shapes but usually in progressive amounts. However, the incidence of a large trade in a particular month can sometimes differentiate prices, particularly intra-day. Traders can take advantage of these small kinks in the price curve with a variety of trades.
Seasonal influences

Sometimes, the contracts covering the year-end, namely the December contracts, can trade at a slightly higher yield than those surrounding them. This is put down to tighter credit conditions in the inter-bank money markets and hence a slight rate premium in the banking system over the Christmas and New Year period. It first became apparent due to a botched liquidity operation from the Federal Reserve Bank in the US during the 1980s and consequently became a pricing characteristic of the market structure, although its effects did diminish during the 1990s. The notion of tighter year-end rates was reinvigorated over the millennium when the December 2000 contracts of all major STIR futures contracts fell sharply on Y2K and bank financing fears, which ultimately proved unfounded. However, the markets do have a memory and, on balance, the December contracts do tend to trade relatively cheaper to their adjacent expiries.

Turning to the other driver of STIR futures …

Price-sensitive effects

Price-sensitive effects are causes that influence the STIR futures price. They include economic data, interest rate sensitive comments by central bankers, influences of other markets and event and systemic risks.

Economic data

STIR futures prices are influenced by the interest rate outlook which, in turn, is dependent on the state of the underlying economy. Economic statistics, reflecting the state of the economy, are released on a monthly basis and some are eagerly anticipated by the markets looking for new direction. Banks, brokers and information vendors provide calendars of impending economic releases and their corresponding forecasts. Some are available free over the internet. (See the Appendices for details.)

Economic releases are usually released at the following times:

- UK: 0930 GMT
- US: 1330 GMT and 1500 GMT (0830 ET and 1000 ET)
- Eurozone: 0700, 0900, 1000 GMT (0800, 1000, 1100 CET)

Economists provide forecasts of upcoming economic releases and financial markets can move significantly in reaction to figures that deviate from their consensus. Some figures are consistently more important than others and some are of more cyclical
importance. Sentiment surveys tend to be cyclical indicators of economic turning points. Most international markets closely watch US economic releases since America is the world’s largest economy and if America catches a cold – as they say – everybody sneezes.

Below is a list of the main economic releases. This is not meant to be a comprehensive list, but includes the main and most consistent market movers. The figures relate to all three economic areas of the United States, Europe and UK unless a release is indicated as being country specific.

Employment

The US figure, Non-Farm Payrolls is probably the most closely watched indicator in world financial markets. It is usually released on the first Friday of each month and is a barometer of whether the economy is creating jobs or not, and so is a reflection of the health of the economy itself. The figure includes both the private and public job data and so needs to be analysed beyond the headline number to see whether one sector has unduly influenced the figure. The private business sector payrolls will be most important and revisions of the previous month’s data can also have price-moving effects. A lower than anticipated Non-Farm Payroll number will tend to cause the STIR futures prices to increase, reflecting the possibility of a slowing economy and lower interest rates. The reverse holds true for a higher-than-anticipated figure.

A weekly jobless figure is released every Thursday but has less influence.

Domestic employment data for other countries will normally have a lesser, local effect.

Gross Domestic Product (GDP)

Gross domestic product is a national report measuring how quickly an economy is growing. It is issued quarterly and is a reflection of economic output. A weaker than expected figure will tend to cause the STIR futures prices to increase. However, bear in mind that the quarterly GDP lags other monthly indicators. This means that the market may well have already anticipated its effect. The figure is released in a series of estimates and then later revised. Watch out for the GDP deflator and price index constituents which are broad indicators of inflationary pressures.

Retail Sales

Retail sales are a monthly report of consumer spending. Retail sales account for approximately 30% of all consumer spending and that itself can account for up to
75% of economic activity. The figures are subject to large revisions in subsequent
months. A lower than consensus number will tend to cause the STIR futures prices
to increase, indicating economic weakness.

Consumer Price Index (CPI)
A very important number for financial markets, being the most popular measure of
inflation in retail goods and services. It is released monthly and a lower figure will
boost markets whilst a higher number will infer higher interest rates since the
majority of central banks target inflation via the setting of interest rate levels. No
monthly revisions.

Producer Price Index (PPI)
PPI, like CPI, is another price level indicator but measures the change in prices paid
by businesses. It is a composite of several PPIs, but the most important component
tends to be the finished goods PPI that can reflect price pressures in the
manufacturing process. It will have the same effects on markets as CPI – some
consider PPI changes to be a precursor for CPI changes. Watch out for the core PPI
number.

Purchasing Managers Index (PMI)
The main US PMI is the Institute for Supply Management (ISM) Manufacturing
Survey, important because it is a private survey issued on the first business day of the
month and represents demand for manufactured products. This in itself is an
indicator of economic activity.

PMIs are also issued by the euro zone and the UK and have similar characteristics.
A number strongly above the median of 50 can cause STIR futures to sell off and a
weak number well below 50 can have the opposite effect.

University of Michigan Sentiment
This US survey is a private indicator of consumer attitudes on the business climate,
personal finance and retail, reflecting a sample of 500 individuals. It is regarded as
being a superior consumer confidence figure and it is released at 0945 (ET) on the
second Friday of each month. It tends to be a more closely watched number at turning
points in the growth of the economy.
Consumer Confidence

Another indicator of consumer outlook. It differs from the University of Michigan figure in that it concentrates more on attitudes to employment and is drawn from a new sample each month.

Durable Goods

A monthly US figure based on future manufacturing activity. Important since it is a forward-looking indicator, gauging production in the months ahead. Durables are goods lasting three years or more. It can be one of the first numbers to indicate a forthcoming change in the state of the manufacturing economy.

Industrial Production

A monthly figure of industrial output, issued in the US, UK, and Europe in the main form of the German industrial production number.

German IFO Business Survey

An important figure issued by the largest economy in the euro zone, and therefore closely watched by Euribor STIR futures traders. It is a predictive indicator of economic performance based upon survey answers from 7,000 German business leaders in the main sectors of manufacturing, retail, construction and wholesale. The figure is presented in three forms: Climate, Situation and the most widely watched Expectations index. The Expectations component is a forward-looking indicator of industrial production and has a good history of forecasting changes.

It is issued in the fourth week of every month. A higher than consensus number will cause Euribor futures to sell off.

German ZEW Economic Sentiment Indicator

The ZEW Economic Sentiment Indicator is released monthly, usually on the second or third Tuesday of the month. Up to 350 financial experts take part in the survey and the indicator reflects the difference between the share of analysts that are optimistic and the share of analysts that are pessimistic for the expected economic development in Germany over the course of six months.
Housing

Housing statistics are regarded as being a good indicator of the state of the economy. The US issues New Home Sales (sales of new single family homes), Existing Home Sales (sales of previously owned single family homes) and Housing Starts (numbers of new homes being built and future construction permits). The main UK figures are the Royal Institute of Chartered Surveyors (RICS) Survey (300 surveyors and estate agents in England & Wales are asked if they feel prices are falling or rising) and a monthly House Price Index issued by the Office of the Deputy Prime Minister. Other surveys are supplied by Nationwide, Halifax, Hometrack and Rightmove.

Table 1.13 – Summary of the effects on STIR futures prices caused by economic releases

<table>
<thead>
<tr>
<th>Economic release</th>
<th>Country</th>
<th>Higher than consensus forecasts</th>
<th>Lower than consensus forecasts</th>
<th>Market effect ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Farm Payrolls</td>
<td>US</td>
<td><img src="" alt="Increase" /></td>
<td><img src="" alt="Decrease" /></td>
<td>High</td>
</tr>
<tr>
<td>US Weekly Jobless claims</td>
<td>US</td>
<td><img src="" alt="Increase" /></td>
<td><img src="" alt="Decrease" /></td>
<td>Low</td>
</tr>
<tr>
<td>GDP</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med/Low</td>
</tr>
<tr>
<td>Retail Sales</td>
<td>All</td>
<td><img src="" alt="Increase" /></td>
<td><img src="" alt="Decrease" /></td>
<td>High</td>
</tr>
<tr>
<td>CPI</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>High</td>
</tr>
<tr>
<td>PPI</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med High</td>
</tr>
<tr>
<td>PMI</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med</td>
</tr>
<tr>
<td>Consumer confidence</td>
<td>US</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med/High</td>
</tr>
<tr>
<td>University of Michigan</td>
<td>US</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med/High</td>
</tr>
<tr>
<td>Durable goods</td>
<td>US</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med</td>
</tr>
<tr>
<td>Industrial production</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med</td>
</tr>
<tr>
<td>Housing</td>
<td>All</td>
<td><img src="" alt="Decrease" /></td>
<td><img src="" alt="Increase" /></td>
<td>Med</td>
</tr>
</tbody>
</table>
Interest rate announcements

Interest rate announcements by the main central banks are of great importance to the STIR futures markets. They are made at regular intervals and are eagerly awaited by the markets. Central bankers do not decide in advance of a meeting as to whether interest rates should be increased or decreased. Instead they analyse the latest statistics and reports, discuss, and then decide. Market expectations are usually guided by central bankers’ rhetoric to align the consensus with the outcome.

U.S. Federal Reserve (‘Fed’)

The Federal Open Market Committee (FOMC) consists of the seven-member Board of Governors and five of the 12 regional Fed presidents. They vote on monetary policy by simple majority. The FOMC holds eight regularly scheduled meetings during the year, and other meetings as needed. They release the result of the vote, along with names of how each person voted, at the same time as they announce the interest-rate decision. The Federal Reserve releases its meeting minutes three weeks later and these are eagerly awaited for indications of future interest rate expectations.

European Central Bank (ECB)

The Governing Council of the ECB meets twice-monthly, but interest rate decisions are usually taken at the first meeting, typically the first Thursday of the month. The ECB decides by consensus, rather than formal vote, of its 18 Governing Council members and a majority carries decisions. However, if there is a tie, the president has the casting vote.

No detailed information is available about how decisions are taken, since no minutes are released and no breakdown of a vote provided.

Bank of England (BOE)

UK interest rate decisions are made by the nine-member Monetary Policy Committee comprising the Governor, the two Deputy Governors, the Bank’s Chief Economist, the Executive Director for Markets and four external members appointed directly by the Chancellor. The interest rate decisions are announced at noon on the Thursday of the first or second week of the month. Decisions of the Monetary Policy Committee are made on a one-person one-vote basis, with the Governor having the casting vote if there is no majority.
BOE policy meeting minutes are usually released on the third or final Wednesday on the month of the policy meeting and are eagerly received by the markets. Policy meeting minutes can be one of the most influential releases for shaping market interest rate expectations.

Central banker rhetoric

The main function of a central bank and its central bankers is the monitoring and regulating of interest rates in the economy.

An old joke goes:

Q. How many central bankers does it take to screw in a light bulb?
A. Just one. He holds the light bulb and the whole earth revolves around him.

In financial markets, it is not so much light bulbs as comments on interest rate policy around which the financial world revolves. Announcements from central bankers are followed closely; every nuance is examined for an indication of the future direction of interest rates. Central bankers have cultivated the art of sometimes saying a lot but revealing little. Speeches can be deliberately obtuse – rarely will bankers be explicit in their commentary.

However, central bankers do inform market participants when their behaviour is not consistent with that of the central bank, or when market expectations need guidance. Sometimes markets will price in a rate rise or cut too aggressively and the bankers need to communicate this via speeches or interviews. This managing of expectations is done in the hope that markets can be smoothly guided to a homogenous viewpoint. The aim is to achieve this with the minimum of price volatility, but it can often create price action in the STIR futures markets.
Case Study: An example of managing expectations – European Central Bank (ECB) 2011

In March of 2011, European central bankers discussed an increase of eurozone interest rates to 1.25% in April 2011 in response to perceived inflationary pressures having kept them frozen at a record low of 1.0% for almost two years.

The press conference of the ECB meeting held on March 3rd provided the platform, resulting in a one-day fall in the Euribor M11 futures of almost 20 basis points (40 ticks) as markets reappraised future rate expectations.

The following are selected ECB board members’ and central bankers’ comments after this meeting.

“Keeping interest rate policy unchanged while headline inflation rises – even if core inflation remains unchanged – implies a de facto allowing for the monetary stance to become more accommodative. Over time this is likely to impact on core inflation.”

LORENZO BINI SMAGHI (EXECUTIVE BOARD), MARCH 4

“A rate hike next month is possible but not certain at this point.”

“Clearly the risks to inflation are on the upside and it is the mission of the ECB to prevent those from materialising, so we are ready.”

JOSE MANUEL GONZALEZ-PARAMO (EXECUTIVE BOARD), MARCH 4

“So far, inflation expectations have remained fairly well anchored, but we know that there are risks with having a number of months with an excessive inflation rate due to the cost of commodities and energy.”

“Some question marks start to arise that some pressure for second-round effects develops, some pass-through is being seen.”

CHRISTIAN NOYER (FRANCE), MARCH 4

“I think President Trichet said the right thing: it’s possible but not on auto-pilot” [on being asked whether a rate hike should be expected]. “I wouldn’t do anything to try to correct market expectations at this point” [on being asked if he is comfortable with market anticipations of an ECB rate rise to 1.75% by year-end].

AXEL WEBER (GERMANY), MARCH 8
“An increase in interest rates at the next meeting of the Governing Council in April is possible, but it is not certain.”

“This is certainly not a decision on the start of a series of interest rate increases.”

JOZEF MAKUCH (SLOVAKIA), MARCH 10

“Strong vigilance is the message that has been given and that is still relevant.”

EWALD NOWOTNY (AUSTRIA), MARCH 14

“The ECB needs to be ready to react immediately to prevent any increase in inflation expectations.”

“We indicated to markets that they should prepare for a re-normalisation of interest rates ... It's better to do it gradually.”

LORENZO BINI SMAGHI (EXECUTIVE BOARD), MARCH 14

The ECB duly raised euro zone interest rates from 1% to 1.25% on 7 April 2011 and went on to increase them further to 1.5% in July. However, the worsening of the European sovereign debt crisis in late summer 2011 and increased likelihood of a global recession resulted in the ECB under the new presidency of Mario Draghi responding by cutting interest rates to 1.25% on 3 November, surprising markets with only a little guidance in advance.

“The role of a central bank under any circumstances, and in crisis times in particular, is to inflexibly pursue its main objective, which in the ECB's case is price stability, and to perform as a key anchor of stability.”

JOSE MANUEL GONZALEZ-PARAMO (EXECUTIVE BOARD), OCT 12

“As the euro area's banking problems have grown worse, changing the central bank's interest rates might not have a significant influence on the financing conditions of companies and individuals.”

ANDRES LIPSTOK (ESTONIA), OCT 18

After November, the rate cut was justified …
On the ECB's decision to cut rates:

“We anticipated the deterioration of the economic situation over the next couple of weeks, so this was a pre-emptive decision. We never pre-commit, but I would like to stress this was a pre-emptive decision.”

JUERGEN STARK (EXECUTIVE BOARD), NOV 4

And rhetoric started guiding markets to expect further rate cuts to 1% in December 2011.

“If there is a situation that we see a serious downturn, or the danger of a serious downturn in Europe, taken together with the perspective of price stability, then I think it's time to rethink and to act maybe in a more decisive way.”

EWALD NOWOTNY (AUSTRIA), NOV 11

Federal Reserve to Publish Rate Forecasts from 2012

Ben Bernanke, the US Federal Reserve Chairman, has signalled a move away from using rhetoric to communicate to markets by announcing a decision to publish internal interest rate forecasts to the markets, thereby creating more specific and unambiguous guidance.

The Federal Reserve Open Markets Committee (FOMC) stated in the minutes of its December 2011 meeting that it was changing the way it communicates with markets.

From January 2012, the US Federal Reserve will replace its current rhetoric of “exceptionally low interest rates … through mid-2013” with interest rate forecasts from each member. All 17 members of the FOMC will also forecast when they expect rates to rise for the first time.

Correlated markets

It has been shown how STIR markets are influenced by yield curve effects, economic news, central banker rhetoric and interest rate announcements. However, the movements of other STIR futures can also affect them and this effect can be observed by the use of the statistical measure correlation.

Correlation is the causal relationship between two comparable entities. It is expressed as either being positive with a value between zero and one, or negative between zero and minus one. An example of a positive correlation is the relationship between smoking and lung cancer, whilst a negative correlation could be that between age and
normal vision. The relationship, either positive or negative, is strongest closest to the respective boundaries of 1 and -1.

International STIR futures markets are highly correlated because of their interest rate parity relationship. Simply put, this means that an equilibrium must hold between the interest rates of two currencies if there are to be no arbitrage opportunities.

The table shows the correlation coefficients between the four main STIR futures representing the currencies of the US Dollar, British pound, the euro and the Swiss franc.

Table 1.14 – Correlation matrix daily data (January 2008 to September 2011)

<table>
<thead>
<tr>
<th></th>
<th>Euribor</th>
<th>Eurodollar</th>
<th>Short Sterling</th>
<th>EuroSwiss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euribor</td>
<td>1</td>
<td>0.956</td>
<td>0.9844</td>
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</tr>
<tr>
<td>Eurodollar</td>
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<td>0.9781</td>
<td>0.9598</td>
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<tr>
<td>Short Sterling</td>
<td>0.9844</td>
<td>0.9781</td>
<td>1</td>
<td>0.987</td>
</tr>
<tr>
<td>EuroSwiss</td>
<td>0.9682</td>
<td>0.9598</td>
<td>0.987</td>
<td>1</td>
</tr>
</tbody>
</table>

It can be seen that most markets have a strong positive relationship to each other over longer periods of time. As one moves the others tend to move in line, with the Eurodollar and Euribor being the main drivers. The EuroSwiss tends to follow the Euribor very closely, since its currency and economy are inextricably linked to the euro.

However, viewing a correlation matrix over a shorter period can reveal a different story …

Table 1.15 – Correlation matrix daily data (January 2011 to Sept 2011)

<table>
<thead>
<tr>
<th></th>
<th>Euribor</th>
<th>Eurodollar</th>
<th>Short Sterling</th>
<th>EuroSwiss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euribor</td>
<td>1</td>
<td>-0.3188</td>
<td>-0.1459</td>
<td>0.3376</td>
</tr>
<tr>
<td>Eurodollar</td>
<td>-0.3188</td>
<td>1</td>
<td>0.2157</td>
<td>-0.8212</td>
</tr>
<tr>
<td>Short Sterling</td>
<td>-0.1459</td>
<td>0.2157</td>
<td>1</td>
<td>0.0508</td>
</tr>
<tr>
<td>EuroSwiss</td>
<td>0.3376</td>
<td>-0.8212</td>
<td>0.0508</td>
<td>1</td>
</tr>
</tbody>
</table>

… showing that correlations are highly variable and are affected by differing economic cycles. For example, during early 2011, the ECB was raising interest rates when most other rates were stationary or decreasing.
Since the advent of electronic trading, trading correlations between contracts has been made easier as most trading software packages allow multi-exchange connectivity from one platform, making it comparatively simple to click and trade, for example, Eurodollar and Euribor.

**Uncorrelated markets**

The influences of correlated markets are quite clear; they tend to be intrinsically linked by their currencies and interest rates. Other markets, such as equities and oil, would appear at first to have little to do with STIR futures and have meaningless correlation coefficients to each other. However, in uncertain times, with (for example) stock market volatility or oil price shocks, STIR futures can focus very closely on a particular agent such as stock index futures or oil prices.

**Equities**

Generally, stock indices are negatively correlated to STIR futures, meaning for example as the FTSE 100 increases, the Short Sterling future might be expected to fall as rates are increased to slow the economy; but the relationship is broad only. Mostly, the causal relationship is not close. However, the effects of 2008/9 on the FTSE 100 reinforced the negative correlation as rates were cut sharply in response.

Fig. 1.12 – FTSE 100 v Short Sterling 1997 to 2011 (thin line – Short Sterling RH Scale, thick line FTSE-100 LH scale, lower pane 50-day rolling correlation)

Source: Reuters
This is the effect that rapidly falling stock markets or event risks tend to be countered by interest rate cuts from central banks to bolster the financial system.

**Oil**

The next chart shows a similar negative correlation effect between the Euribor Z8 contract and the price of oil, which reached an all-time high in July 2008. The largely negative correlation is due to the economic argument that high oil prices can be inflationary and so interest rates should rise and Euribor futures fall.

*Fig. 1.13 – Brent Crude Oil v Euribor Z8 2007-2008 (thin line – Euribor Z8 LH scale, thick line – Brent oil RH scale, lower pane 50 day rolling correlation)*

**Event risk**

Event risk is the term applied to the effect of unforeseen events on the STIR futures price, usually natural disasters or acts of terrorism.

Ever since, the World Trade Centre attacks of 11 Sep 2001, event risk premium due to the flight to quality has become more prevalent. Events or rumours of events will rally STIR futures prices as investors seek out safe havens and less volatile environments for their funds. Speculators also magnify this effect, trading instruments like STIR futures and bonds that will benefit from central bank intervention. Both the European Central Bank and Federal Reserve cut interest rates in the aftermath of 9/11 to restore confidence to financial markets and ease credit.
Event-risk premium tends to be short-lived and its influence is usually restricted to the period of perceived threat. In past years, 9/11, the Madrid train bombing and the London Underground bombings have all affected the STIR futures markets.

The next chart shows the effects of the London bombings on 7 July 2005 on Short Sterling M6 STIR futures. A 25-tick spike on the day, driven on a flight to quality sentiment, was soon corrected as traders realised there were unlikely to be any significant knock-on economic effects. Sentiment-driven markets tend to become pragmatic rather quickly.

Fig. 1.14 – Short Sterling M6 June 2005 to July 2005 intra-day tick

**Systemic risk contagion**

STIR futures can also influence each other via systemic risk. This is the risk that a localised problem in a financial market could cause a chain of events that has a knock-on effect on other markets. For example, a default by a major market participant, such as the bankruptcy of hedge fund Long-Term Capital Management in 1998, can cause liquidity problems for a number of counterparties to those funds. This can cause those counterparties to fail on their own obligations, prompting a liquidity crisis in the financial markets. This is usually countered by interest rate cuts and so STIR futures rise on a global basis.
Conclusion

In conclusion, the reader should now hopefully be aware of what STIR futures are, how they are priced and what influences cause them to move. They might also have awareness that they are unlike most other kinds of financial instrument and can offer a myriad of different trading approaches and risk profiles. The next section deals with the mechanics of STIR futures markets, which includes clearing and settlement, and how the markets are accessed.
STIR Futures
Trading Euribor and Eurodollar futures
Stephen Aikin

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