Interest Rate Futures

Interest rate futures are based on the same concepts as forwards but it could be argued were developed to overcome some of the contracting problems in the FRA market. Futures provide a more standardised means of engaging in forward transactions as they are traded through an organised exchange, are not OTC products and thus not tailor made to individual client's requirements. They have a similar outcome to FRAs in that if, a futures contract is used to hedge a position, then one is *locked in* to a rate no matter which way the actual rate moves. Interest rate futures are based on particular types of financial instruments; whose prices are dependent on interest rates. Therefore, an important difference is that FRAs are quoted by rate (yield) but futures by price. However, there will be a relationship between the price of a future and the forward rate for the same period

All the major interest rates are now traded. They have seen a large growth in volume due to the growth in the volume of the underlying assets and the increased volatility of interest rates. We will consider the financial futures traded on the London International Financial Futures Exchange (LIFFE). Trading through the exchanges means that all trades are anonymous without specific knowledge of the buyer and the seller. The Exchange consolidates transactions improving the chances transactions can be matched and therefore provides liquidity to the market.

Short term interest rate futures can be used to protect against the risk of changes in short term interest rates. Hedging the risks posed by long term interest rates can be achieved using long term bond futures. Interest rate futures enable investors, who intend to borrow or lend in the future, to lock into a rate of interest today. This is useful if the objective is to hedge against unexpected changes in interest rates.

An investor intending to borrow at a future date may be concerned about an unexpected rise in interest rates, whilst an intending lender may be concerned about an unexpected fall in interest rates.

You can also use interest rate futures for speculative purposes. An investor who holds a point of view about the future direction of interest rates, that is not reflected in the current term structure of interest rates, may decide to take naked positions in interest rate futures. This is extremely risky as huge losses from speculation are just as likely as huge gains, unless the speculator knows something the rest of the market does not.

STIR futures are traded on derivative markets. We shall use examples from LIFFE where the principles and practices are consistent with other derivatives markets. The following STIR futures are traded on LIFFE[1]

One Month EONIA
Three Month Sterling
Three Month Euribor
Three Month Eurodollar
Three Month Euroswiss
Three Month Euroyen

[1] Definitions and more information on these products can be found on the Euronext.liffe website.

For illustrative purposes we shall concentrate on the three-month sterling interest rate futures. The 'underlying asset' for 3-month sterling futures is the 3-month rate of interest in the London money market. This is the 'London Inter-Bank Offered Rate', commonly known as LIBOR.[2] The last trading day of the contracts is the third Wednesday of the delivery month, with expiration at 11.00. Delivery is on the next business day. Similarly, the underlying asset for 3-month Euribor is the Euro Inter-Bank Offered Rate.

The futures prices in table 5 were extracted from the LIFFE website, and are the settlement prices at close of trade on **11th January 2024**.

Table 1Three Month Sterling futures on 11th January 2024

Contract	Settlement price	Open interest.
20th March 2024	99.56	464,262
19th June 2024	99.53	600,556
September 2024	99.59	442,942
December 2024	99.35	426,450
:	:	:
:	:	:
Dec 2024	99.11	8,185

'Open interest' is futures jargon meaning the total number of contracts outstanding. As each contract has a buyer and a seller, open interest is both the number of short positions and the number of long positions in the market.

Consider the March futures contract. It has a settlement price of 99.56. This is the price at which contracts were traded at the end of the day. The price is expressed as 100 minus the 3-month LIBOR expected to prevail at expiration of the contract.[3] This expectation is the forward rate implicit in the term structure of spot rates. The relevant calculation is demonstrated later in this section.

The 3-month rate is expressed on an annualised basis. Hence the rate of interest implicit in the futures price is 0.44% (100 – 0.44 = 99.56). Hence, 0.44% is the 3-month sterling rate of interest expected to prevail on 20th March. Contracts are cash settled[4] at the delivery date unless the investor engages in a reversing trade before then. One contract is based on £500,000 nominal. Futures prices tend to change day by day as interest rates and expectations change. As the expiration date approaches the futures price and the spot price converge.

How STIR Futures Work

Buyer of a contract (**Long** position)

The buyer contracts to lend a notional £500,000 at 0.44% on the March delivery day.

Seller of a contract (**Short** position)

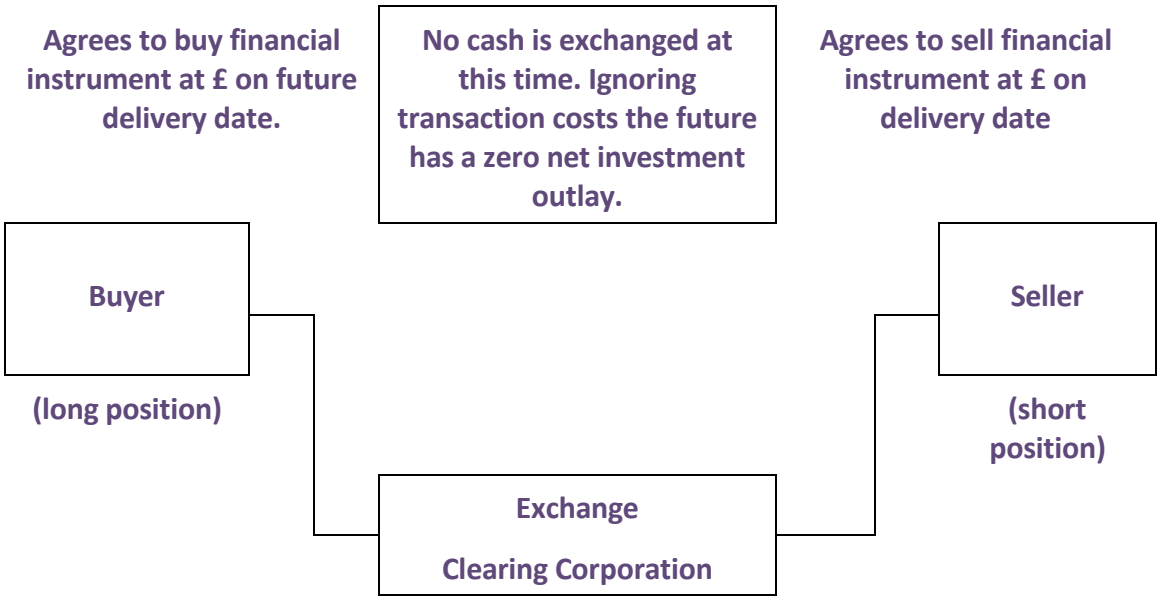
The seller contracts to borrow a notional £500,000 at 0.44% on the March delivery day.

[2] An interest rate is not an asset as such. LIBOR is a benchmark rate in the sterling market.

[3] Reminder that expiration is 11.00 a.m. the 3rd Wednesday of the delivery month.

[4] Not least because there is no deliverable asset, i.e. an 'interest rate' cannot be delivered.

The procedure is illustrated as follows:



As the market price of the futures moves for a particular delivery date, holders of open futures contracts will be in a position to identify corresponding profits and losses from their holdings. The standard nature of each futures contract makes such gains and losses easy to measure and monitor.

Hedging using financial futures aims to reduce the risk of loss through adverse movements in interest rates by taking a position in a financial futures contract that offsets the existing or anticipated position in the cash market. The undertakings are 'notional' because the actual borrowing or lending does not take place. Instead there is a cash settlement.
The essential features of a futures contract are therefore:

- Type of Futures Contract

We must select the appropriate futures contract. For example, if you have borrowings based on 3 month LIBOR the short sterling futures contract will be 3 month LIBOR.
In long term interest contracts if the contract remains open at the expiry date then the seller has to make physical delivery of the underlying financial instrument. We are concerned in this section primarily with short term interest rate futures.

- Number of Contracts

The number of contracts to trade will depend on the instruments we are attempting to hedge and the contract size. The contract size states the quantity to be delivered. If we are hedging a borrowing of £10 million based on three-month sterling we would divide the amount to be hedged with the contract size of £500,000 with the result that we would need 20 contracts. The other variable to consider is the maturity of the cash market instrument relative to the maturity of the instrument underlying the futures contract.
Ideally, to use futures contracts to hedge short term interest exposure, we need:

a. a coincidence of the exposure dates to the delivery dates of the relevant futures contracts.

b. the amount to be hedged to be achieved with an exact number of hedge contracts.

It is unlikely that the exposure will fulfil these requirements but many borrowers and lenders now try to manipulate their market exposure to equate these conditions. The basic number of contracts we need can be given by:

$$\frac{\text{FACE VALUE OF EXPOSURE}}{\text{FACE VALUE OF CONTRACT}} \times \frac{\text{EXPOSURE DATES}}{\text{CONTRACT DATES}}$$

For example, to hedge a 6-month exposure of DM 20 million starting on the futures delivery date of December 2022, the number of contracts required would be:

$$\frac{\text{DM 20 Million}}{\text{DM 1 Million}} \times \frac{\text{6 month}}{\text{3 month}} = 40 \text{ contracts}$$

We need to double the number of contracts because the price change to any given movements in interest rates in instruments with longer maturities is greater than for the same instrument with a shorter maturity.

This assumes that the exposure period rate and the futures rate correlate perfectly. Usually we refine this naive assumption and consider the historical correlation between these rates and apply the regression co-efficient to this formula.

We should note that we must sell futures contracts to hedge against rising interest rates and buy interest rate futures to hedge against falling interest rates. This is the opposite to FRAs. The futures contract has the effect of transferring risk between the two counterparties, since the buyer will benefit if the price rises and the seller if the price falls.

Cash Settlement

Assume at expiration on 20th March the 3-month spot rate of interest is 0.66%, so (due to convergence) the final settlement price on the futures contracts is 99.34 (i.e. 100 – 0.66). Cash settlement occurs on the delivery day.

Loss to Long Position

The buyer is notionally committed to lending £500,000 at 0.44%. As the spot rate on the delivery day is 0.66% this represents a loss of 0.22%. It is a loss because the investor could have loaned at 0.66% but is committed to lend at 0.44%. Hence, the loss on £500,000 is:
£500,000 × 0.0022 × ¼ = £275

The ¼ converts the annualised rate to a 3-month rate.[5] This can also be shown as:

Gain (loss) to long futures $= (F_T - F_0) \times ¼$

$= (99.34 - 99.56) \times ¼ = -0.22\% \times ¼ = -0.055\%$

−0.055% of £500,000 is −£275

£275 is the cash settlement which must be paid by investors who are long in a contract purchased on 11th January 2022.

[5] The convention for futures on interest rates of less than 1 year is to use simple interest. So the 3-month rate is simply ¼ × annual rate and, similarly, the annual rate is 4 × 3-month rate

Tick Value

The minimum price movement is known as the tick size. This is the basic hedging mechanism as a profit or loss on a futures contract is determined by:

Number of TICKS the price has moved up or down x Tick Value x Number of Contracts.

The monetary value of one tick is dependent upon the size and the terms of the contract. One **tick** is 1/100 of 1 percent (0.01% or 0.0001) i.e. change in price from 93.51 to 93.52. The Tick values are usually given or they easily can be calculated as:

Tick Value = 1/100% x ¼ of year x face value of contract

For example, for the three month Eurodollar contract this would be:

0.0001 x 0.25 x $1m = $25

The minimum price movement is known as a 'tick'. One tick in 3-month sterling futures is a movement of 0.01 in the futures price. A movement from 0.44% to 0.66% is 22 ticks. The futures price has moved down 22 ticks from 99.56 at the time of the contract to 99.34 at expiration.

The value of one tick is £12.50.[6]

Hence, the loss to the long position = −22 × £12.50 = −£275.

Gain to a Short Position

Using the same figures, it is clear that a seller of a March contract at 99.56 gains £275. The seller is notionally committed to borrowing at 0.44% which is 0.22% lower than the actual 3-month borrowing rate on the March delivery day.

[6] £12.50 = £500,000 × 0.0001 × ¼

Example 1 – Hedging with Futures (note in these examples we assume no basis risk)
Tissot Ltd has $80m in BORROWING with a three monthly rollover due on 1st December, they can borrow at LIBOR. In October they decide money market interest rates are going to rise substantially above the current rate of 0.6%. Their strategy would be to sell three-month interest future contracts. If in three months' interest rates have risen as expected the gain realised when the futures contracts are bought back should approximately offset the higher interest cost.

3 month Euro $ contracts	Price	INTEREST
	99.4	0.6%
	(100 – 0.6)	

- 3-month repricing of borrowing therefore we need a 3-month contract
  $80 million/$1 million = 80 contracts (CONTACT SIZE $1 MILLION)

  At 1st December the price of 3-month Euro $ contracts are 99.2 (0.8%) and the interest rate is 0.8% for 3-month Euro $ borrowings.

HOWEVER THE FUTURE PROVIDES CERTAINTY AT 0.6%.

Cash Flows

Cash Market	**Futures Market**
October	October
CERTAINTY rate 0.6%	Sell 80 Dec. Euro $ contracts at 99.4
$80m x 0.6% x 3/12 =$0.12 MILLION	
Interest cost would be	$80m x 0.6% x 3/12 = $0.12 million
December	December
Rollover loan at 0.8%	Buy 80 Dec Euro $ contacts at 92.0 Profit on contract
Actual interest $80m x 0.8% x 3/12	= (99.4 – 99.2) x 80 x $25 = $40,000
$0.16 MILLION	
Additional cost ($0.16m-$0.12m)	Profit
$40,000	$40,000

The profit on the futures contract exactly offsets the additional cost on the borrowing.
The effective interest cost of the borrowing would be:
Actual interest ($80m x 0.8% x 3/12) - Profit on the future ($40,000) = $120,000. The effective interest rate would of course be 0.6%:

$$\frac{\$120,000}{\$80,000,000} \times \frac{365}{91} = 0.006 = 0.6\%.$$

This is a perfect hedge with 100% efficiency.
If the actual interest rate fell between October and December Tissot would make a loss on its futures contract but would pay lower interest on its borrowing which would give them an effective interest cost of approximately 6% no matter how interest rates move in the interim.

Example 2 – Hedging with Futures (note in these examples we assume no basis risk)
Assume it is 11th January 2024. A corporate treasurer expects her company to receive an excess cash flow of £100million in mid-March. The company has long term business investment plans for the cash but it is not needed until later in the year. On receipt of the cash it will be deposited for about 3 months at the prevailing rate of interest. Today's 3-month sterling interest rate (LIBOR) is 0.68%. The market expects future rates to fall, as is evident in the futures prices, but the treasurer is worried that they will fall even further than expected. She therefore decides to lock into the short term rate in the March futures contract. The March 2024 3-month sterling futures price is 99.56, i.e. 0.44%
Strategy: Buy March futures contracts.[7]
Number of contracts: £100million ÷ £500,000 = 200 contracts.

Outcome: In early March the company has £100 million to invest for 3 months. Assume interest rates have in fact fallen and the 3-month LIBOR is now only 0.3%.
The interest on £100 million invested at 0.5% over 3 months is £100million × 0.003 × ¼ = £0.075million However, there is a profit on the futures contracts. The futures price in mid-March will reflect the market's expectations of 3-month LIBOR at the expiration date. As there are only a few days to go, expectations will be close to the prevailing rate of 0.3%. Therefore, we hypothesise a futures price of 99.70. This means that in mid-March the market believed 3-month LIBOR on 20th March would be 0.3%. In these examples we generally assume convergence of spot and futures price.
Gain from futures = $[(F_T - F_0) \times 100]$ ticks × £12.50 × 200 contracts
= [(99.70 – 99.56) × 100] ticks × £12.50 × 200 contracts
= 14 ticks × £12.50 × 200 = £35,000.
The gain of £0.035m added to the £0.075m interest gives a total of £0.11m. This represents a return on £100m of 0.11% which is 0.44% on an annual basis. In fact, it will be slightly more than this because the £0.035 cash flow from the futures can also be invested for 3 months at 0.3%.

- Pricing

The price of a short term interest rate future is quoted as 100 minus the market interest rate on a three-month deposit. For example, if the three-month interest rate is 0.87% the future will be priced as 100 - 0.87% = 99.13. On the last day of trading - when the contract is settled against three-month cash market rates the futures price will converge with the cash market price. This type of close-out arrangement is called cash settlement.

- Initial Margin and Daily Margin calls

An important feature of the exchange is to act as a clearing house. The exchange assumes the risk of default risk with all open positions. This removes the concern of individual participants to determine the default of the other side of the contract. The exchange imposes a number of requirements on individual counterparties. These are called margins and are basically a deposit to ensure that both parties meet their liabilities in the transaction. The margin is not an investment. To ensure the financial soundness of its contracts and to reduce counterparty credit risk the exchange will require an "*initial margin*" for each open position to be deposited with the clearing house. This will be returned when the position is closed. This provides the

[7] 'Buy' simply means enter contracts to buy (long contracts).

exchange with liquidity. On a daily basis all open future positions are "*settled to the market*" rather than at the end of the contract. This is called "*marked to market*". Profits and losses resulting from price changes are paid to and collected from clearing house members daily. These collections and payments are known as the "*variation margin*".

For example, assume the initial margin in the US financial futures market on a financial future contract is $750 and the tick size is $25. If you buy a June financial future at 99.80 and the closing price that day is 99.78 what is the total margin you must make?

Day 1 **Initial Margin** = $750

The price has moved against you two ticks as the selling price is lower than the price you have agreed to buy at, therefore you pay a variation margin of

Variation Margin = 2 ticks x $25

Total $800 Payment

The following day, the closing price is 99.81; what margin payment is made?

Day 2 The price has moved in your favour i.e. upwards and therefore you will have gained over the day 3 ticks.

Variation Margin 3 ticks x $25 = $75 receive

Self Assessment Question 1

On the third day you sell a June future at 99.82; what total margin do you receive on your financial future?

Some exchanges also impose daily price limits whereby any price movement above the limit will stop trading in that contract on a particular day.

Self Assessment Question 2

Attjuner Plc has an investment of £200 million on which it receives three-month £LIBID. The treasurer's view is that interest rates will fall before the next rate fixing on 1st June. She decides to hedge the position with futures contracts. The date now is 10th March; the price of a June futures contract is 89.00; the initial sterling margin is £1,000 per contract; the current three-months £LIBID is 11%.

At 1st June the following information is available:

The futures contract stands at 90.00.
Three months £LIBID is 10%.
The contract size is £1,000,000
The tick size is £25

Analyse the transactions and evaluate the hedge.

Self Assessment Question 3

Lit-Dale plc has borrowing of £250 million on which it pays three-month £LIBOR + 4.5 per cent. The treasurer's view is that interest rates will rise before the next rate fixing on 1st June. She decides to hedge the position with futures contracts. The date now is Feb 21st; the price of June futures is given below.

INTEREST RATE FUTURES

Feb 21		Open	Sett	Change	High	Low	Est. vol	Open int
Euribor 3m*	May	–	95.80	-0.03	–	–	–	–
Euribor 3m*	Sep	96.24	96.18	-0.09	96.25	96.12	263,256	594,825
Euribor 3m*	Dec	96.41	96.36	-0.09	96.41	96.29	266,433	540,061
Euribor 3m*	Mar	96.49	96.46	-0.08	96.50	96.39	204,292	428,107
Euroswiss 3m*	Mar	97.28	97.27	-0.01	97.28	97.26	5,187	62,708
Euroswiss 3m*	Jun	97.44	97.45	-0.02	97.47	97.38	15,804	62,596
Sterling 3m*	May	–	94.36	+94.36	–	–	–	–
Sterling 3m*	Jun	94.73	94.67	-0.08	94.74	94.61	106,810	611,767
Sterling 3m*	Sep	95.02	94.97	-0.09	95.04	94.88	179,448	534,966
Sterling 3m*	Dec	95.26	95.20	-0.08	95.27	95.11	169,694	497,535

Futures information

The contract size is £500,000

The tick size is £12.50

The initial margin is £500.

Set up the hedge on the 21st February using the appropriate terminology (applying a total exchange spread of 0.08 to the average futures settlement price).

At 1st June the following information is available:

The futures contract stands at 96.60.

Three months £LIBOR is 3.4 per cent.

Illustrate the cash flows in the money market and the futures market, clearly setting out the effective return.

Advantages of Futures Contracts

Futures positions can be closed out very simply as we have a traded market. The credit risk is very small because of the way the exchanges are set up. The high degree of liquidity enables participants to open and close positions economically and easily whilst the clearing house effectively underwrites investor risk.

Disadvantages of Futures Contracts

Although not really a disadvantage, it is clear futures have a speculative image. They are not an OTC contract but traded on a derivative market which, in general, have a poor reputation in the light of a number of losses experienced by users of these markets. Treasurers seem also to be put off by the demands of monitoring performance and in using brokers.

Other more practical problems are the standardisation of the contracts in terms of financial instruments, dates and amounts which can mean that perfect hedges are not possible with the underlying financial instrument. Also the standardised dates of settlement can mean that the future closeout rate will not exactly match the cash market rate. During the life of the contract the future rate and the cash market rate will not always move together. Arbitrage will keep them together but may not keep them identical. Perfect hedges are therefore rare because of this basis risk. These problems can be magnified if there is only limited interest in the contracts being traded.

Self Assessment Question 4

You are the treasurer of a large UK company and decide to use futures to hedge your interest rate exposure. Your managing director is sceptical and needs convincing as she would prefer to use FRA. Write a report suggesting some of the advantages of futures over FRAs.

Interest Rate Options

We will consider Traded Options which are traded on LIFFE.

Traded Options

Exchange traded options are options on the underlying futures contracts. LIFFE offers options on several financial futures contracts. To protect against rising interest rates put options would be purchased and to protect against falling interest rates call options would be purchased.

Bayern Plc has £5,000,000 to invest in three-month sterling and want to ensure a minimum future return for cash planning purposes, but also want to benefit from any sharp increases in interest rates. It buys a call option. Note this is an option on an interest rate future – investors BUY futures. The cost of a call option with a 91.00 strike price is 20 ticks (= 0.20). This guarantees a minimum rate of: 100 - 91.00 - 0.20 =8.80%

With a contract size of £500,000 Bayern will need 10 contracts to hedge this investment. If interest rates fall to 8% (implying a future price of 92.00) Bayern will invoke the option and sell the call option which gives it a right to buy at 91.00 for 92.00 realising a profit of 1% or 100 ticks. The profit will therefore equal:

(100 ticks less cost of option 20 ticks) x 10 contracts x £12.50 = £10,000

This will be added to the 8% earned on the investment:

8% x 0.25 x £5,000,000 = £100,000

Total earnings will equal profit plus interest:

£100,000 + £10,000 = £110,000

Effective yield:

$$\frac{£110,000}{£5,000,000} \times \frac{12}{3} \times 100 = 8.8\%$$

This is, as expected, the future price less the cost of the option.

Hedging options has the attraction of being able to guard against adverse movements in exchange rates or interest rates whilst leaving unimpaired the ability to profit from favourable movements. It also allows contingent cash flows to be hedged which is not possible through the use of futures alone.

Self Assessment Question 5

Illustrate the cash flows in the Bayern example if interest rates rise to 11%, calculating the effective cost and the effective yield.

Ajax Plc is a net borrower. Note borrowers SELL interest rate futures and therefore a PUT option is appropriate. They require to hedge a borrowing of £1,000,000 based on three-month Euro-

sterling. This would require two contracts. The put option available has a strike price of 91 with a cost of 20 ticks. The maximum borrowing rate is therefore: (100.00 - 91.00 + 0.20) = 9.2%. If interest rates fall to 7% the put option will be allowed to expire for the cost of:

20 ticks x 2 contracts x £12.50 = £500

This must be added to the total effective interest cost of:

7%	x	£1,000,000	x	0.25	=	£17,500
+	cost of option £500				=	£18,000

The effective cost is:

$$\frac{£18,000}{£100,000} \times \frac{12}{3} \times 100 = 7.2\%$$

Essentially the cash outlay of 20 ticks means that Ajax is protected against interest rate risk. This is worse than the unhedged position but the protection on the maximum interest cost gives the company a profit and loss profile which is appropriate to their degree of risk aversion.

Self Assessment Question 6

Illustrate the cash flows in the Ajax example if interest rates rise to 12% (reflecting a futures price of 88), calculating the effective cost and the effective yield.

Self Assessment Question 7

Construct two alternative hedges to protect the interest on a cash surplus of £50 million expected to occur for three months starting in four months' time and calculate any premium due. Today is 1st January 2024. Assume options expire on the 1st day of the month. Market information

FRAs

3v6	5.50 - 5.64
4v6	5.48 - 5.62
4v7	5.46 - 5.60

3-month LIBOR Sterling exchange-traded ICE Futures Europe interest rate options % (p.a.)

Strike Price	Calls		Puts	
	May	Aug	May	Aug
94.50	0.080	0.360	0.220	0.230

Contract size £500000

Tick size £12.50

Compare the results of each hedge based on actual (outturn) three-month LIBOR on 1st May 2024 of:

(1) 5.20

(2) 5.80

Calculate the % breakeven actual (outturn) rate for which both hedges give the same result.

What other factors would you take into account when choosing between these instruments and why?