

### *Further Reading*

**John C. Hull, 'Options, Futures, and other Derivatives'.**

Earlier editions can be used

**Don Chance, 'An Introduction to Derivatives and Risk Management',.**

As with Hull's book, earlier editions can be used.

## **Financial Risk Reduction - Techniques in Hedging**

Before we can discuss the hedging techniques, it is extremely important to realise that companies will not always necessarily hedge their exposure due to several factors. For example, the exposure might be very small in relation to the company's size, or the treasurer might have a strong view that rates are going to move in their favour or that transaction costs may be too high in relation to the exposed position. Another valid reason for not hedging is the timing. If cash flow projections show that the exposed position will be removed very quickly, for example, we could pay back an exposed debt position - whether through generated profit, through asset disposals, or through the raising of capital through a rights issue; clearly it would not be a very good hedge to enter into a five-year hedging instrument if it is not likely that the debt would be on the balance sheet for more than one year. However, it is often necessary to use hedging techniques and we will now consider some of the commonly used instruments that treasurers could use to manage any exposed position.

### **Hedging Instruments - Derivatives**

A 'derivative' is so called because it derives its value from another asset, which is known as the 'underlying asset'. The underlying asset is usually traded in a spot market, also called a 'cash' market. Futures contracts are traded in futures markets. The underlying asset is the asset on which a futures contract is based. The underlying asset is often just called the 'underlying'. Marks & Spencer (M&S) shares are the assets underlying futures contracts on M&S shares. Gold is the asset underlying futures contracts on gold, US dollars are the assets underlying futures contracts on US dollars, and so on.

Hedging may be defined as the partial or total elimination of risk by taking some compensating action. There seems to be an assumption that hedging eliminates risk completely, but this is not the case. How much risk is transferred to a third party and how much is retained depends upon:

- the hedging instrument that is used;
- how closely the price movement of the hedging instrument correlates with the underlying security; and
- how closely the amount hedged matches the amount of risk.

Consequently, hedging is not an exact match, but it narrows the probability distribution of outcomes. In order to evaluate a hedge, it is important to consider all the possible costs as most hedging strategies involve transaction costs.

A hedger is trying to protect the value of an underlying cash position (an asset or of a liability) or an anticipated cash position from adverse interest rate movements. The purpose of hedging is to limit risk rather than make money. On the other hand, a speculator has no underlying cash position to protect and is simply aiming to make money. Speculators use several factors including economic indicators to predict future interest rates. They take a position and therefore adopt risk. They are important to many markets as they provide liquidity through their continual trading. Arbitrageurs interact with the market to take advantage of price discrepancies between different markets. In practice it can be very difficult to distinguish between these different market players.

### 1.1. Activity

Write a sentence using the following words to describe **hedging**, **arbitrage** and **speculation**.

**Hedging** - REDUCE ACTION EXPOSURE

**Arbitrage** - DISCREPANCIES CAPITALISE IDENTICAL MARKETS

**Speculation** - WITHOUT POSITION UNDERLYING UNFAVOURABLE

### Hedging Instruments – outcomes

Risk management instruments generally permit us to do one of three things:

- lock into the present rate for future periods, for example futures or forwards.
- opt for variable rates or fixed rates, for example swaps.

These two strategies can be described as symmetric as the instruments hedge by offsetting changes in the market value of the underlying security, thus locking in an effective price for the security. They can be described as providing *certainty*, as there is a definite change in interest rate profile effected by these instruments.

- Improve the risk profile by use of options - for example caps, floors and collars.

This strategy can be described as asymmetric as it offers protection against the decline in the market value of the underlying instrument but allows participation in favourable movements. These instruments provide *protection* like insurance, as they offer flexibility, whereby a worse case is known but scope still exists to benefit from advantageous rate movements.

We can break down these instruments into the time horizon in which they would be used and the main benefit from their use in terms of whether they provide "*certainty*" or whether they offer "*protection*".

	Short term	Long term
<b>Certainty</b>	<b>Forwards</b> <b>Financial futures</b>	<b>Swaps (1 - 10 years)</b>
<b>Protection</b>	<b>Options</b>	<b>Caps, floors and collars</b> <b>(&lt; 18 months)</b>

Some of these instruments are described as "*Over The Counter*" (OTC) as they are provided from banks and financial institutions (for example, forward rate agreements, interest rate

swaps and interest rate caps). Others are market based and traded on an exchange (for example, financial futures and interest rate options). A generic term which is used to cover all of these instruments is 'derivatives'. We can define derivatives as contracts or traded instruments which are based on an underlying cash instrument or index.

### Activity 1.2

Tick the blanks regarding the characteristics of hedging instruments in the following table:

Instrument	Time Horizon		Source		Effect of Instrument	
	Short term	Long term	Over the counter	Exchange traded	Insurance	Certainty
Swap						
Future						
Option						
Forward Rate Agreement						

## Managing Interest Rate Risk

In the previous chapter we identified interest risk and saw some of the problems it poses for company treasurers. In this section we will consider some of the external techniques treasurers can use to hedge this risk.

After completing this section, you should be able to:

- discuss some of the different ways companies can approach the technique of interest rate management;
- describe some of the commonly used hedging techniques such as forward rate agreements, financial futures, interest rate options, interest rate caps, floors and collars and interest rate swaps;
- calculate the effect of using these techniques on the borrowing cost or investment income; and
- compare the characteristics of each hedging technique and discuss their advantages and disadvantages.

## Company Strategy

Most companies are net borrowers, with fixed and real assets such as factory or equipment bringing in a return from major business activities. The hedger will try and maximise the return on assets and minimise the funding cost of liabilities. Hence if a company expects interest rates to fall, they will give preference to floating rate funding. When interest rates are expected to rise companies will prefer long-term fixed rate funding methods. Consequently, when a company borrows it must decide between fixed and floating based on their view of interest rate movements. But if the companies do not have this type of funding, they can use hedging instruments to achieve the same effect by switching from fixed to floating or vice-versa. Where there is uncertainty as to future interest rate movements the hedger will use different instruments to increase flexibility. This is not necessarily speculation since if we decide to go with fixed or variable or improve the risk profile, we are simply concerned with optimising an unavoidable decision.

For a company that is a net borrower with a floating rate interest exposure the following options would therefore be available to them:

- borrow either in the public or private markets on a floating rate basis and use an interest rate swap to convert the floating rate debt to fixed rate debt;
- borrow on a floating rate basis and use forward rate agreements (FRAs) to convert the floating rate debt to fixed rate debt;
- hedge the interest rate exposure in the financial futures market;
- hedge the interest rate exposure by an interest rate option; and
- limit the floating rate of interest by an interest rate cap or collar.

Once a borrower has decided that it would be beneficial to hedge their interest rate risk, the technique selected will depend on the borrower's access to alternatives based on their credit rating, the maturity of the debt and the relative pricing of the available techniques.

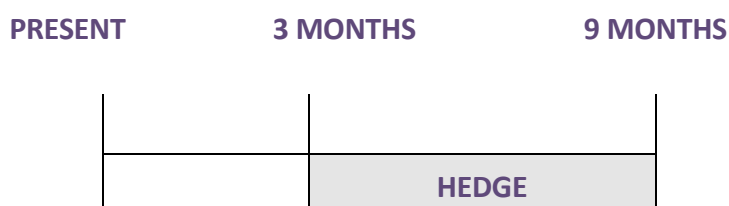
### Forward Rate Agreements - Definition

Forward Rate Agreements (FRAs) are well named as they simply refer to an interest rate forward in time. FRAs allow borrowers to lock in today an interest rate to start at some future date. In using a FRA, the treasurer makes a "*bet*" on the future direction of interest rates. With the passage of time, this will either yield a profit or loss. It is used extensively for covering short term interest rate exposures for periods up to two years. The formal definition of a FRA would be a contract between two parties to agree an interest rate on a notional amount with a specified maturity at a specific future date and to make payments to each other computed by reference to changes in the rate. They exchange an interest rate differential on a predetermined amount during a given time period, based on an agreed future interest rate basis during that period. The buyer is wishing to protect itself against a future rise in the interest rate. The seller will obtain protection against a drop in interest rates by agreeing to a fixed future rate. FRAs involve no change in the principal amount and are concerned with the interest element only. The exposure to both parties is only the interest difference between the agreed rate and the actual settlement rate. To hedge an interest rate exposure, the notional amount of the FRA should equal the principal amount of the borrowing or investment.

By using a FRA, you are exchanging one type of risk for another. By fixing the rate in the future you transfer the interest rate risk onto a counterparty. At the same time, you assume a credit risk that the counterparty in the FRA contract will be able to make the required payment on the interest differential. This credit risk is very small for treasurers as their counterparty is usually a bank or financial institutions. However, treasurers usually have limits on the amount they can contract with individual banks or institutions. The arrangement of a FRA and the underlying borrowing or deposit are two separate transactions, generally carried out with two separate banks or financial institutions.

In a FRA agreement we will specify the following:

- Notional Principal Amount  
We must specify the notional principal on which the interest differential will be exchanged.
- Period Covered  
We must express the period covered by the agreement in FRA terminology. For example, a "*three against nines*" OR "*3 versus 9*" means that the FRA will commence in three months' time and last for six months. For example,

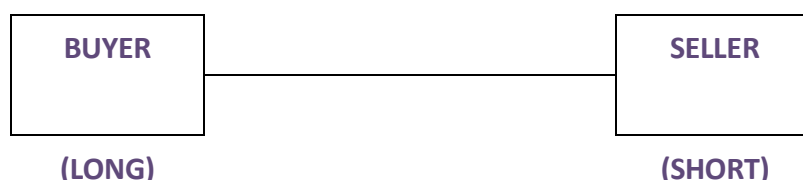


In principle, FRA could involve any broken amount and any future time period, although normal practice will confine transactions to amounts in full millions and monthly periods such as:

1 month in 1 month, 1 month in 2 months,....., 1 month in 11 months  
 2 months in 1 month, 2 months in 2 months, ..., 2 months in 10 months  
 3 months....  
 .....  
 10 months in 1 month, 10 months in 2 months  
 11 months in 1 month.

A forward rate is quoted each day but the dates covered will obviously differ.

- Reference Rate  
Generally, the reference rate is LIBOR or LIBID.
- The buyer of a FRA is protected from rising interest rates as they pay fixed interest and are long funded since they will benefit from the FRA if rates increase. The seller (floating payer) of a FRA is protected from falling interest rates and is therefore short funded.



There is no premium paid for a FRA as there is a winner and a loser at settlement. However, there can be an arrangement fee paid to the FRA provider and of course the spread on the FRA is the transaction cost.

- The start of the FRA contract is often referred to as the value date or settlement date and the end of the contract period is referred to as the maturity date. The day the contract is agreed is referred to as the deal date or the transaction date.
- To aid the growth of the FRA market many of the contracts have been standardised under "FRABBA" terms specified by the British Bankers' Association.

### Activity 1.3

You agree a contract with your bank whereby in three months' time, if six month Libor is greater than 3% you will pay interest calculated as Libor - 3% and if six month Libor is less than 3% the bank will pay you interest calculated as 3% - LIBOR. In each case interest is calculated on £1,000,000 for six months.

Express this contract in standard FRA terms:

Fixed Payer

Floating Payer

Contract Amount

Contract Period

Contract Rate

Reference Rate

Who is "buying the FRA"?

The example below illustrates the use of a FRA for hedging purposes. Apple Ltd has a £10 million loan (variable rate) and would like to be certain as to what rate of interest it will be charged on the loan for the three-month period commencing 3 months from the present (January 20th). (We are ignoring bid-ask considerations in this example).

Apple wants to hedge the period three months to six months as shown below:

PRESENT January 20th	3 MONTHS April 20th	6 MONTHS July 20th
		HEDGE

Apple enters a FRA contract with Scotbank to receive income on a contract amount of £10 million if, in three months, three-month LIBOR is more than what is expected given today's yield curve (the three-month rate in three months). If the three-month forward rate is 1.5%, Scotbank would agree to pay if the settlement rate (rate in three months) were above 1.5% and would receive compensation from Apple if the rate were below 1.5%.

Let us assume that the parties agree to the contract on January 20th for an April 20th spot date for determining the settlement rate, with actual transference of funds occurring two business days later -April 22nd (the settlement date). Therefore, FRAs are settled against the actual interest rate prevailing at the beginning of the period to which it relates.

What happens if on April 20th the rate is exactly 1.5%? Nothing. Neither Apple or Scotbank receives or pays compensation. Apple Ltd will pay 1.5% on its loan.

However, suppose on April 20th the three month LIBOR rate determined by the reference rate in the contract is 2.5%. The 1% increase in rates would require the notional lender (Scotbank) to compensate the national borrower (Apple Ltd). The money received would redress the rise in the rate of interest on Apple's floating rate loan from 3-6 months. Apple would therefore offset the increased cash outflow due to the rate increase on the loan with a cash inflow from Scotbank.

If, however, the interest rate falls the compensation payment will be in the opposite direction so the company would have lost on its FRA but gained from the lower interest rate on its variable loan. In either case the interest rate uncertainty is removed.

With an actual rate of 2.5% how much does Scotbank pay to Apple? There is a standard formula for the calculation of the settlement but before resorting to the formula, let us see if we can think it through logically. The FRA is settled on the first day of the interest rate period of the agreement. The settlement is determined as the difference between the interest on the contract amount based on the actual reference market rate at the time and the agreed forward rate. The notional amount is £10 million; the difference in settlement and contract rates is 1.0%; and the contract was for 92 days. First, we need to know how much 92 days of interest differential is worth for £10 million:

$$(\pounds 10,000,000) \times (0.01) \times (92/365) = \pounds 25,205.48$$

This is the value after holding another three months to July 20th; however, the payment is going to be made at settlement (20th April), so this amount must be discounted by the three-month LIBOR in effect (i.e. the actual market rate). In other words, because the interest payments usually fall at the end of the interest period and the settlement of FRA takes place at the beginning of the interest period, the settlement amount should be discounted back to the time of the settlement i.e. the beginning of the period, for example:

$$\frac{25,205.48}{1 + [0.025 \times (92/365)]} = £25,047.64$$

We get precisely the same answer if we utilise the formula provided by the British Bankers Association which is given below:

When the market rate is above the agreed forward rate the settlement amount is calculated as follows:  
 Settlement Amount =  

$$\frac{(\text{Market rate} - \text{Agreed Forward Rate}) * \text{Principal of FRA} * \text{No. of Days in Interest Period}}{(365) + (\text{Market Rate} * \text{Number of days in the interest period})}$$
  
 Where the market rate is below the agreed forward rate the equation reads:  

$$\frac{(\text{Agreed Forward Rate} - \text{Market Rate}) * \text{Principal of FRA} * \text{No. of Days in Interest Period}}{(365) + (\text{Market Rate} * \text{Number of days in the interest period})}$$
  
**NOTE:** In Sterling LIBOR is quoted on a 365 Day year. Most other currencies quote interest rates on a 360 day year.

For Apple Ltd. the settlement amount in their favour would be calculated as:

$$\frac{(0.025 - 0.015) \times 92 \times £10,000,000}{365 + (0.025 \times 92)} = £ 25,047.64$$

#### Example 1.1 – FRA cashflows

Consider a company, Barrie Plc, which has borrowings of £100m on a floating rate basis at a cost of three-months £ LIBOR. The treasurer expects interest rates to rise before the next rate fixing date at 1st of April. At the current date, 1st February, the interest rate is 0.5% and 3 v 6 FRA can be BOUGHT at 1.5%. The treasurer decides to hedge Barrie's exposure by using a FRA. As the treasurer expected, interest rates did rise and at the 1st of April three month £ LIBOR was 2%.

To evaluate the FRA for hedging the interest rate exposure:

**2 February:** BUY 3 v 6 FRA at 1.5% for £100 million

**1 April:**

Roll over loan at £100m x 2% x ¼ = (£500,000)

Close out FRA

Receive  $\frac{(0.02 - 0.015) \times £100m \times 92}{365 + (0.02 \times 91)} = £125,402$

The actual rate is greater than the FRA rate so payment must be made from the FRA provider to Barrie Plc.

**Effective total cost:** £500,000 - £125,402 = £374,598

**Effective interest cost:**  $\frac{£374,598}{£100,000,000} \times \frac{365}{91} = 0.015 = 1.5\%$

This is the funding cost that we wanted to achieve when we undertook the FRA.

#### Forward/Forward Rate - The Forward Settlement Rate

The FRA evolved from what is called the "*forward/forward contract*". A function of the yield curve is to tell the treasurer where interest rates will be in the future. If the three-month rate from the yield curve is 5 1/4% and the 6-month rate is 5 1/2% there is an interest rate which can be implied from three months forward for another three months. This is called the



"forward/forward" rate. The "forward/forward" rate is the rate at which the principal and interest on the initial transaction (for three months) are reinvested for the next three months. This should breakeven such that the total interest received on a deposit is equal to the total interest paid on a borrowing over the same period. The forward rate is simply an interest rate quoted for a period of time beginning in the future and ending further in the future. It is implied since we do not know what the actual spot rate will be in the future.

FRAs are usually settled against LIBOR rather than LIMEAN since most of the FRA are traded in London and are therefore tied to LIBOR. An adjustment of 1/16% is usually made to this theoretical forward rate. FRAs are also priced with a spread with a selling rate (bid) and a buying rate (offer). This operates differently from normal markets so make sure you follow which way round the quote is. The lower rate is the bid at which the market maker will pay fixed and receive LIBOR and the higher rate is the offer at which the market maker will receive fixed interest and pay LIBOR. Note FRAs are products and offered by a number of dealers (banks). Clients will choose the "best" quote they can get from the banks. Each FRA dealer can also quote differences in the price of the FRA and therefore the treasurer should ensure that they get more than one quote to get the cheapest price. Effectively, if you buy a FRA you will pay fixed and receive floating and if you sell a FRA you receive fixed and pay floating. This terminology will be used again when we look at interest rate swaps.

#### Example 1.2 – FRA Dealers

Three FRA are priced as follows:

		Dealer 1	Dealer 2
1	3 v 6	5.65 - 5.60	5.66 - 5.61
2	6 v 9	5.71 - 5.65	5.73 - 5.68
3	9 v 12	5.78 - 5.72	5.80 - 5.75

Moham Plc seeks interest rate protection for a six month period beginning in six months' time. The amount of proposed borrowing is £5,000,000 and forecasts are for an increase in rates over the period of the loan which is based on a three month LIBOR basis. They therefore need to buy two FRAs covering the final six months of the loans life as there are two repricing periods (3 month LIBOR) within this time. This is called a "*strip hedge*" as it consists of two separate FRAs covering 6 to 9 months and 9 to 12 months. They must consider the bank's selling rates. If we look at the information above Moham would buy at 5.71 and 5.78 from dealer 1 as these prices are cheaper.

#### Activity 1.4

Three FRAs are priced as follows by two dealers:

	Dealer 1	Dealer 2
3 v 6	1.65 – 1.60	1.66 – 1.61
6 v 9	1.72 – 1.65	1.73 – 1.68
9 v 12	1.78 – 1.72	1.80 – 1.75

Senibridge Bank Plc seeks interest rate protection on a borrowing for a nine-month period beginning in three months' time. The amount of the proposed borrowing is £5,000,000 and forecasts are for an increase in rates over the period of the borrowing, which is on three-month LIBOR basis. Set up the hedge using the appropriate dealer and the relevant hedge terminology. Illustrate the cashflows in month 3 only and prove that the effective rate achieved in month three is the FRA rate at initiation of the contract. The actual rate in month three is 1.9%.

### Advantages in Using FRAs

The first and obvious advantage is that we achieve a guaranteed rate for a specific period. FRAs are also popular because of their flexibility in that they can be tailor made to meet the requirements of the customer. There are no margin calls (which we will describe for futures) and they do not have to be fitted into standard sized contracts and delivery dates. They are an OTC product and they have low administration requirements. They are off-balance sheet as they do not appear in the financial statements. There is no cash outlay at the beginning of FRA except perhaps an arrangement fee. They are suited to high volume hedging.

### Problem in the FRA Market

- take advantage of the first problem is obviously the large down-side risk attached if the company cannot accept favourable movements in interest rates. However whatever the rate the company agrees in the FRA should be acceptable for them and favourable movements should be viewed as opportunity costs.
- No organised market. Forward contracts are flexible regarding their size and settlement date and can be tailored to meet individual treasurer's needs. However this flexibility can make it difficult for the FRA provider to find a suitably matched counterparty to the transaction. As a result a FRA may not be available to meet your exact needs.
- Bid/Offer Spread. The number of FRA providers is not particularly large and this means that there are wide bid/ask spreads particularly in times of volatile interest rates.
- Default risk. In a FRA one side of the contract gains while the other loses. This can give incentives for one of the counterparties to default. In general, FRAs are only available to large well known established companies. The credit risk on a FRA does tend to be fairly small compared to the principal involved. However, there is an administrative cost to banks in extending any credit and therefore banks tend to deal in FRAs with a customer only if the expected volumes are greater or if other business justifies the expense of maintaining a credit line.
- Liquidity. A forward is assumed to be held until the settlement date. Cancellations are rare and usually costly. If you find you no longer want the FRA as rates have moved in your favour and you are unable to take advantage of this you may want to unwind the transaction. There are three courses of action available to the treasurer:
  - i. Assignment of the obligation to another party  
This could require some compensation payment to the new party to assume the obligation and approval by the FRA provider.
  - ii. Cancellation of contract  
This could involve the payment of a cancellation fee if the counterparty is willing to cancel the contract.
  - iii. An offsetting position

This may not be possible due to the inability of finding a counterparty. If a counterparty can be found there may be some difference in settlement prices. In addition, this doubles the default exposure.

**Activity 1.5**

You are in charge of marketing for a large investment bank. Write an advert for FRA describing their advantages over a non-hedged position.