Understanding Bond and Repo Markets

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Objectives of the Course

- Defining and describing the bond markets and bond mathematics
- Introducing bond market analytics, including the yield curve
- Understanding market fundamentals and applying knowledge gained to daily work in various aspects of the bond markets
- Introducing the different instruments, including interest-rate derivatives
- Covering the UK gilt market

Agenda

Introduction to Bond Markets

Definition, financial arithmetic

Yield measurement

Different types of yield measurement

Review of market instruments

The Yield Curve

Interest rate risk

Duration, modified duration, convexity

Corporate Bond Markets

Eurobonds

Agenda (cont.)

- The Gilt Market
  - Structure, Settlement, I-L, Strips
- Introducing repo markets
- Money Markets
- Risk Management
- Off-balance sheet instruments
- Overseas Bond Markets
- Emerging Markets

Introduction to Bonds

Definition of bonds

- Bonds are debt capital market instruments. They are defined by:
- Types of issuer

  Sovereign, supra-national, local government, corporate
- Term to maturity
- Principal and Coupon rate

  Fixed, floating and zero rates; payment frequency; interest basis (act/365, act/act, etc)
- Embedded options

  Call, put, convertible

Market participants

- Borrowers : the “issuers” referred to
- Investors

  --short-term investors, banks, building societies, local authorities

  --medium-term, corporates, insurance companies

  --long-term, life companies, pension funds
- Hedge funds - aggressive, leveraged investors
- Intermediaries, traders, brokers

Financial Arithmetic : PV, FV

The principles of compound interest are used to show that £1 today is not the same as £1 in the future

- The effect of a (real) rate of interest
- Given a rate of 10%, we would select £1 today or £1.10 in one year
- The further into the future, the greater the compensation requirement for interest foregone because of the effect of compounding

Compounding, Discounting and Present Value (cont.)

- Compounding : a future value FV (given a present value, a time period *n* and interest rate)
- FV = Present Value (1+ Rate of Interest)^n
- To analyse the potential economic benefit of future cash flows whose nominal value is known we employ the principle of discounting, the converse of compounding
- Discounting : value of sum receivable at a future date *today* (present value PV)
- PV = Future Value / (1+ Rate of Interest)^n

Time value of money (cont.)

- So, present value analysis is a means by which future values can be converted into comparable present day terms using the discounting principle
- This fact is important towards understanding zero-coupon bond markets
- A future sum to be received which includes compound interest can be expressed in relative terms to £1 today
- The actual calculations to obtain the ***discount factors*** are rendered unnecessary by the discount function table

Internal Rate of Return

- The internal rate of return or yield for an investment is the discount rate that equates the present value of all the expected cash flows to zero.
- Use to find the “breakeven rate of return” in corporate finance and project appraisal
- If we assume that the IRR is the discount rate that will apply to reinvestment of all cash flows, IRR becomes the *yield to maturity* for an instrument

Fair pricing of bonds

- Vanilla Bond : pays fixed interest (coupon) annually or semi-annually , with return of principal at maturity
- *Fair price* of such a bond given by the discounted present value of the total cash flow stream, using market-determined discount rate (for this type of bond)

- The bond price / yield formula given here relates to annual coupon bond with complete years to maturity, an even number of coupon payment dates, no accrued interest

Example 1.2

Basic Price Equation

$$P = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \ldots + \frac{C}{(1+r)^{T-1}} + \frac{C}{(1+r)^T} + \frac{M}{(1+r)^T}$$

$$= \sum_{t=1}^{T} \frac{C}{(1+r)^t} + \frac{M}{(1+r)^T}$$

where

P = fair price of bond

C = coupon

M = redemption payment (par)

T = number of years to maturity

r = required rate of return on bond

Price / yield formula (semi-annual coupons)

$$P = \sum_{t=1}^{2T} \frac{C/2}{(1+\frac{1}{2}r)^t} + \frac{M}{(1+\frac{1}{2}r)^{2T}}$$

Estimate yield from two trial values for *r* , then solve using formula for linear interpolation

Assumes coupons are re-invested at the required rate *r*

Clean and Dirty Bond Prices

- In most markets the convention is to quote bond prices as *clean*
- The final consideration paid in a trade is the *dirty price*, which is the clean price plus accrued interest
- The clean price will move with changes in market interest rates
- Assuming steady rates, the dirty price will increase steadily from one interest payment date until the next, at which point accrued interest is zero
- Day count basis; Ex-dividend period

Eurobonds: no ex-div period

Accrual Day-count Convention

- Accrued interest calculation will use the day-count basis for that bond
- actual / 365, eg., Japan, South Africa
- actual / 360, eg., Australia
- actual / actual, eg, USA, UK, Euro
- 30 / 360, eg., Eurobonds

Bond Yield Measurement

Yield Measures

- Current Yield

  [C/P] x 100
- Simple yield to maturity

  [C/P] + [100-P]/[n x P]

Yield to Maturity

- *Yield to maturity* (or *gross redemption yield*) is the most frequently used measure of return from holding a bond
- Paragraph 2.3 in text!
- YTM is equivalent to the *internal rate of return* on the bond, the rate that equates the value of the discounted cash flows on the bond to its current price.
- Solution solved by linear interpolation
- Gross redemption yield because assumes no withholding tax; for *net redemption yield* use C(1-tax rate) in equation

Yield to maturity (cont.)

- Remember the way yields are quoted before making comparisons; **annual** or **semi-annual yield**? Can convert one to another with standard formula (para2.3)
- YTM is not the *actual return* that will be realised from holding a bond, but an *anticipated* yield. It is not a "true" yield.

  Coupon reinvestment rate uniform during life of bond

  Bond held to maturity

- The yield on a zero-coupon bond is a true interest rate

Yield to call / put

Callable Bonds

- A callable bond can be called at issuer's option, usually on pre-set dates
- If the bond is trading above par - that is, the coupon (interest rate being paid by issuer) is above the current market interest rate, calculate yield to first call date (Bloomberg term is *yield to worst*).
- If the coupon is trading below par, calculate to redemption date
- Reverse applies for *put-able* bonds

Index-linked yields

Index-linked bonds

- *Index-linked bonds* have their coupon and redemption payment linked to an index, such as a retail price index or commodity index
- Coupon and principal payable are scaled up by ratio of index level at issue and current index level
- Two kinds of yield : *money (*or *nominal yield*) and real yield
- Money yield assumes an inflation rate
- Lag in applying inflation uplift means not totally inflation-proof

Price and yield relationship

- For a conventional bond with fixed coupon, the price is the only variable that can change to reflect changes in the market environment
- When coupon rate is equal to the market rate (for that type of bond!), bond price will be par
- As rates increase, bond price will drop to reflect higher yield required
- As rates drop, price will increase

Price / yield (cont.)

- Bond prices will move for various reasons, including

  - change in yield required by the market, due to change in base rate or credit quality

  - change as bond approaches maturity

  - change in yield of comparable bonds
- Liquidity reasons
- Supply and demand reasons

Review of Bond Instruments

Floating Rate Notes (FRNs)

- FRNs are bonds that have variable rates of interest through their life
- The coupon usually pays a fixed spread over a reference index, such as 3-mo or 6-mo LIBOR, set with coupon frequency
- As future cashflows not known, cannot calculate redemption yield
- On coupon date, priced at par. Trade around par between coupons. More akin to a money market instrument
- *Simple margin* method of measuring return

Caps, collars, floors

Variable Rate Note

Asset-backed bonds

- Many different types of bonds fall into the category of asset-backed bonds
- Bundled securities, formed from packaging together a set of non-marketable assets (*securitisation*), such as credit card debt, car loans, mortgages
- Advantages to original lender; attractive to investors
- Credit quality
- Additional risk : prepayment risk
- Yield calculation: spread over Treasury, and *average life*

PIBS

- Peculiar to UK market
- Similar to bank *preference shares*, issued by building societies, irredeemable bonds
- Tax deductible for builders, so attractive loans
- Issued at time of high base rates, plus very attractive spread over gilts (up to 200 bps over) for quality credits
- Some bonds trading at over 200 per cent! (eg., Skipton PIBS)

Bonds with embedded options

- Certain bonds are issued with embedded options, which can result in them being redeemed early
- The main types are *callable* and *put-able* bonds. They are issued under specified terms and dates at which they may be redeemed
- Callable bond: considered as long position in straight bond and short in call option; the issuer will call if rates fall and it wants to re-finance at lower rate. To compensate investors therefore callable bonds have higher yield than equivalent vanilla
- Put-able bond: view as long in straight bond and long in a put option, holders will *put* the bond to issuers if rates rise
- Yield analysis by *option-adjusted spread*, most common way calculates *yield to worst*

Bloomberg terms

Index-linked bonds

- Bonds issued that link coupon and redemption payments, or one of these, to some price index
- Choice of index to link payments to, retail? commodity?
- Indexation lag (to allow for calculation), means not completely inflation proof (eg., UK linkers 8 month lag)
- Coupon frequency : usually semi-annual
- Yield calculation - assume a stable inflation rate and adjust cash flows accordingly
- Indexing cash flows :

  - interest indexed

  - capital indexed

  - zero-coupon index

  - indexed annuity

The Yield Curve

Yield Curve

- **Accessing capital markets**

  The pricing of debt instruments revolves around the yield curve. This curve, or *term structure of interest rates*, describes relationship between yield and maturity on stock differing only in term to maturity

- **Types of Yield Curve**

  Yield to maturity yield curve; Coupon yield curve; Par yield curve; Spot (or Zero-coupon) yield curve; Forward yield curve

- **Shape of the Yield Curve**

  Expectations of market participants of future course of interest rates; Liquidity preference theory; Segmentation theory

Theories of the yield curve

- Expectations hypothesis

  Investors expect short-term interest rates to rise (positive shaped curve), a function of expected rate of inflation
- Liquidity preference theory

  Higher risk, preferred maturity of lenders versus borrowers, *liquidity premium*
- Segmentation hypothesis

  Investors requirements at certain parts of yield curve, eg., banks, pension funds
- Recessionary expectations
- UK curve - euro and inflation expectation
- Information content of yield curve

The spot rate yield curve

- It is possible to derive zero-coupon or *spot* rates from observed yields and prices in the coupon bond market
- The technique is known as *bootstrapping*
- Using the bootstrapping method we can calculate spot rates along the entire term structure
- The zero-coupon curve is a true rate curve, often used to derive *forward rates*, when determining relative value of bonds, and when pricing new issues
- Spot curve will lie above a positive sloped redemption yield curve

Present values of issue's shorter cash flows discounted at rates lower than yield; the higher PV's produce a lower PV for final cash flow, this lower PV has higher yield

Deriving spot rates, using hypothetical gilt yields, settlement 1/3/99 (coupon date)

Maturity Date	Years to maturity	Coupon (%)	Yield to Maturity	Price
1-Sep-99	0.5	0.0	6.00	97.0874
1-Mar-00	1.0	10.0	6.30	103.5322
1-Sep-00	1.5	7.0	6.40	100.8453
1-Mar-01	2.0	6.5	6.70	99.6314

If we use £100 as par, the cash flows from the one-year coupon gilt are :

0.5 years	**10% x £100 x 0.5**	**£5**
1.0 years	**10% x £100 x 0.5**	**£5 + £100 redemption**

We can then show the present value of this cash flow to be as follows :

$$\frac{5}{(1+y_1)} + \frac{105}{(1+y_2)^2}$$

y_1 is half of the six-month theoretical spot rate
y_2 is half of the one-year theoretical spot rate.

Deriving spot rates (cont.)

We know the six-month spot rate to be 6%, therefore the present value of the one-year coupon gilt is

$$\frac{5}{(1.03)} + \frac{105}{(1+y_2)^2}$$

As the price of the one-year gilt is 103.5322 the following relationship must be true :

$$103.5322 = \frac{5}{(1.03)} + \frac{105}{(1+y_2)^2}$$

Using this relationship we are now in a position to calculate the one-year theoretical spot rate is as shown below.

$$103.5322 = 4.85437 + \frac{105}{(1+y_2)^2}$$

$$y_2 = 0.03154$$

Doubling this yield gives us the bond-equivalent yield of 0.06308, or 6.308%, which is the theoretical one-year spot rate.

The process is continued at 6-month intervals along the term structure, as long as prices and yields of coupon bonds are known

Forward Rates

Breakeven principle: forward rates must be arbitrage-free, giving the same holding period return from fixed rate / reinvestment strategies

Relationship
[R is the forward rate starting 1 period from now]
[r_2 is the 2-period interest rate]

$$(1 + r_2)^2 = (1 + r_1) \cdot (1 + R)$$

$$R = \frac{(1 + r_2)^2}{(1 + r_1)} - 1$$

Forward Rates (example cont.)

Breakeven calculation :

Total funding cost = Total Return on Investments

$(1+0.12)^2 = (1+0.1) \times (1+R)$

$(1+R) = (1+0.12)^2/(1+0.1)$

$(1+R) = 1.14036$

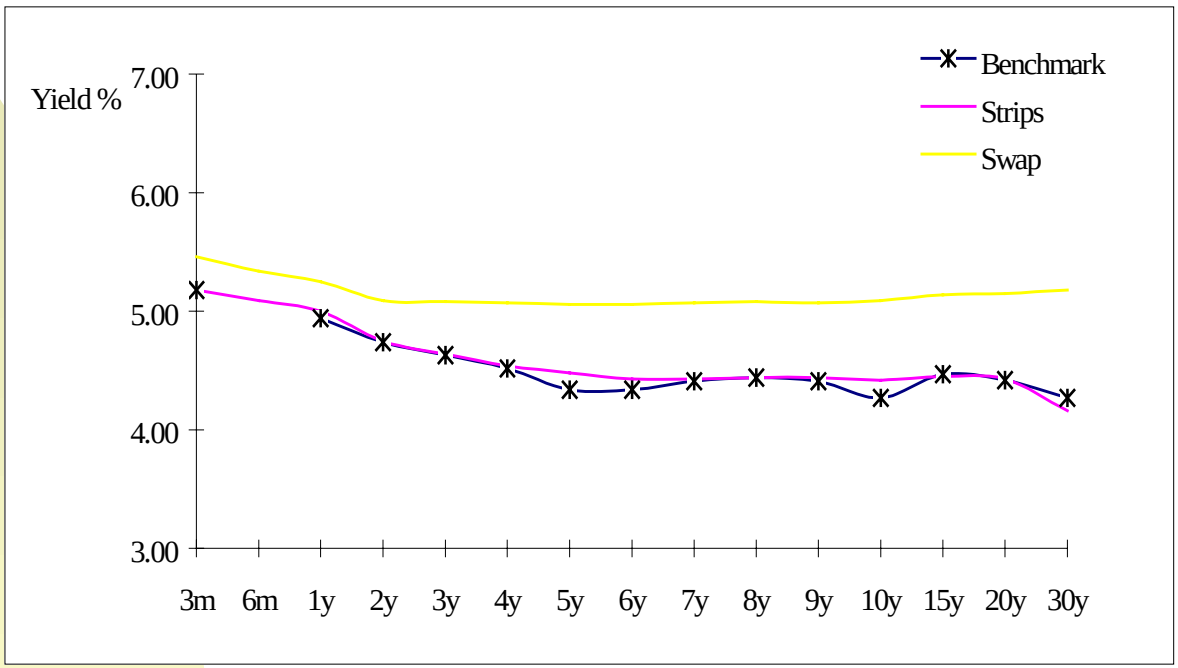
R = 14.04% [1yr fwd-fwd rate breakeven]

Benefits of positive carry are passed on to forward price

Refer to forward rates example in textbook

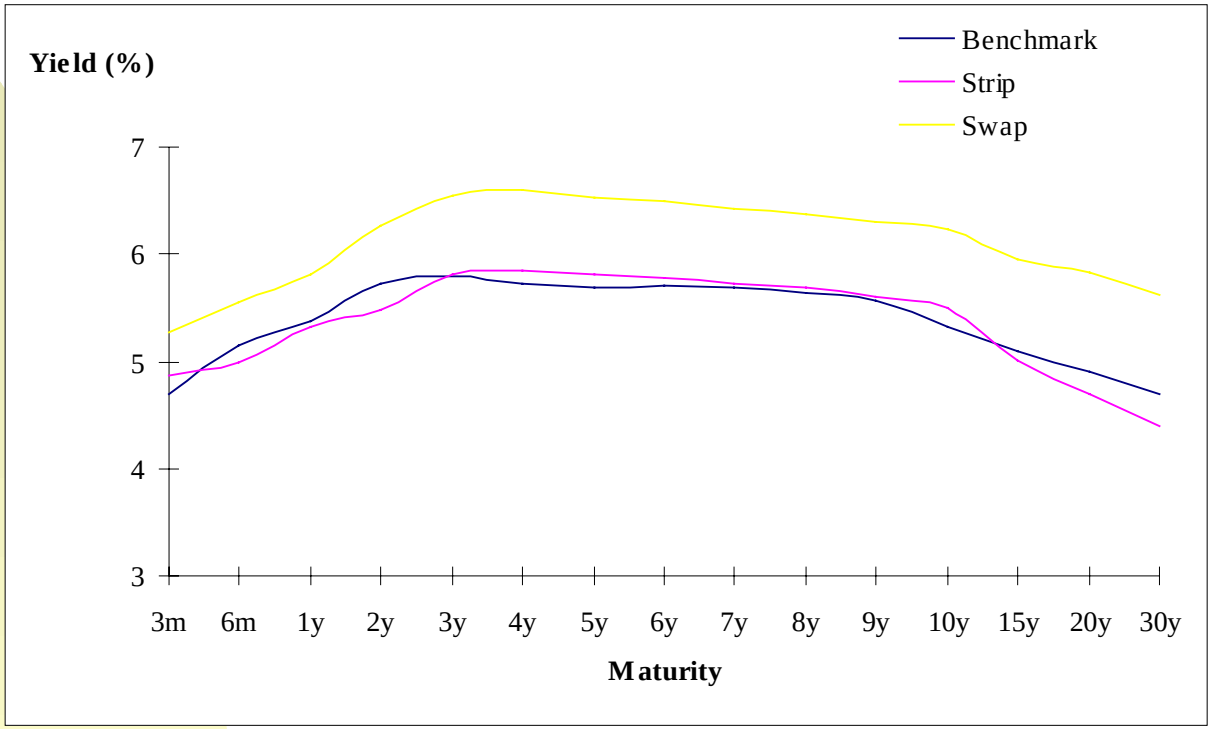
Forward yield curve

UK yield curve Feb 1999



(Source : Bloomberg)

UK yield curve 30 July 1999



(Source : Bloomberg)

Interest Rate Risk Measurement

Price / Yield Relationship

- Price equation shows the relationship between bond price and interest rate.

  The percentage increase in price when yields decline is greater than the percentage decrease when yields rise. This is due to the convex relationship between price and yield.

- The maturity of a bond gives us little idea about the actual length of time to receipt of a bond's total return (because some of the cash flows are received during the bond's life)

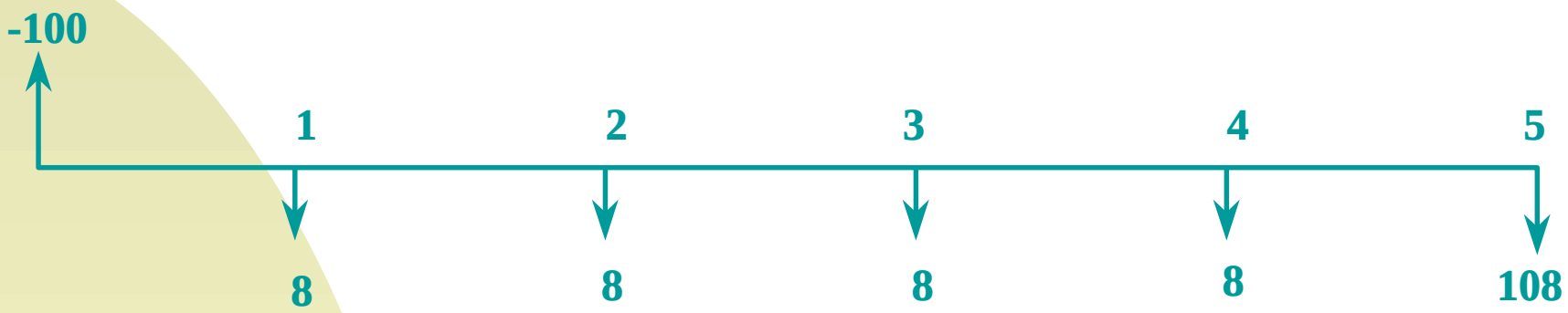
- In effect, the "actual" time to maturity is measured by *Duration*, measured in years

- Sensitivity of the bond to changes in interest rate is measured by *Duration* and *Modified Duration*

Duration

- The maturity of a bond gives no indication of the timing or size of its cash flows, and hence its sensitivity to moves in interest rates
- We can measure speed of payment of a bond (and hence its interest rate risk relative to other bonds) by measuring the average maturity of the bond's cash flow stream
- *Macaulay's Duration* is the weighted average time (in years) until receipt of cash flows from a bond, where weights are present values of the cash flows

5-Year Eurobond Coupon: 8% Yield: 8.00% Price: 100
What is Macaulay Duration?



	CF	PV @ 8%		Timing (T)	PV x T
1)	8	7.41	[8/1.08]	1	7.41
2)	8	6.86	[8/(1.08)(1.08)]	2	13.72
3)	8	6.35		3	19.05
4)	8	5.88		4	23.52
5)	108	73.50		5	367.51
		100.00			431.21

Duration = 431.21/100 = 4.31 years

Properties of duration

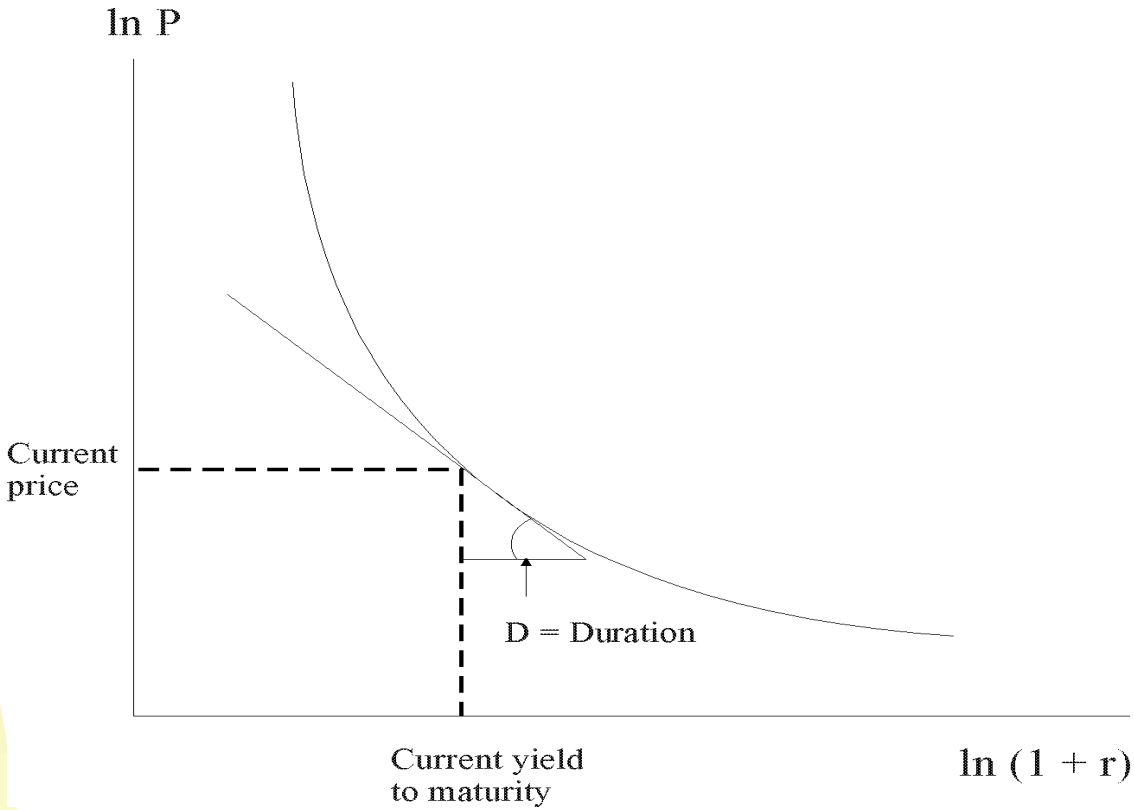
- A coupon bond's duration is always less than its term to maturity
- Duration for a zero-coupon bond is equal to its term to maturity
- Higher duration results from :

  --lower coupon

  --lower yield

  --broadly, longer maturity
- Index-linked bonds have higher duration (low coupons), as do strips

Price / Yield profile and Duration



Modified Duration / Convexity

- The ***modified duration*** of a bond measures the sensitivity of a bond's price to small changes in yield
- Relationship to duration

  MD = D / (1 + r)
- **Basis point value**
- Convexity

  A second-order measure of interest rate risk; measures the *curvature* of the price / yield profile

  A measure of the error made in using MD

  A more convex bond will outperform one of lower convexity whatever the change in rates

Duration for other securities

- Money market instruments

  --short term; discount instruments duration equal to maturity

- Futures contracts

  --cannot be calculated as above (no cash flow); determine effect on portfolio volatility using fut's volatility, then use net vol to calculate duration

- Interest Rate Swaps

  --view as long and short positions in coupon bond and FRN; net the volatility of both components, and the effect of this vol on portfolio as a whole

  --in practice fixed side used in "duration weighting", using BPV of swap

Corporate Debt Markets

Corporate bonds - Basics

- Large part of US debt markets, smaller proportion in Europe
- Same features as other bonds described, but with element of credit risk
- Security - fixed assets or floating
- Provisions for paying off bonds - sinking funds
- Junk bonds

Convertible bonds

- *Convertibles* are bonds that can be converted to ordinary shares of the issuing company
- Conversion price is par value of bond divided by *conversion ratio*
- *Conversion premium, conversion value*
- Attraction for bondholder lies in structure being a combined vanilla bond and option; option component acts as hedge on downside while allowing bondholder to gain from increase in share price

Warrants

- A *warrant* is an option issued by a firm to purchase a given number of ordinary shares (equity warrant) or debt (bond warrant)
- Often attached to bonds, as sweetener
- Value is intrinsic value (*formula value*) and time value

(Share price - exercise price) x number new shares issued

Medium-term notes

- MTNs are corporate debt securities ranging in maturity from nine months to 30 years
- Unique characteristic is that they are offered over a period of time, usually as part of a continuous *MTN programme*
- Accrued interest paid on 30/360 day basis
- Unsecured debt, so can be tapped only by quality borrowers (although “junk” MTNs issued as well)
- Liquid secondary market

Commercial paper

- Short-term unsecured promissory note
- Range in maturity from 30 to 270 days
- Trades as *discount instrument*
- Also issued as part of continuous programme, say five-year £100 million
- Issuers often roll over debt
- Credit protection to guard against investor dis-interest in form of standby credit facility
- Higher yields than T-Bill, for credit and liquidity reasons

Credit Ratings

- Investors seek assurance in quality of bonds bought, using *name recognition* or formal *credit ratings* (short of their own credit assessment)
- Issuer will seek formal rating, from agency such as S&P, Moody's, IBCA
- "Investment grade" regarded as AAA/Aaa to BBB-/Baa3 (often cut-off for banks is Baa1); below that "speculative"
- Ratings kept under review

Eurobonds

British Gas, Disney

- Bonds distributed internationally when sold, often denominated in different currency of issuer domicile
- Often 5-10 year maturity, but up to 30 years and beyond issued, in variety of currencies
- Unsecured, lower rated borrowers supply *covenants* as sweeteners to investors
- IPMA; ISMA
- Issued by *syndicate* of international banks, lead manager has bid to be the lead
- “Grey market”

Eurobonds (cont.)

- Secondary market, ranges from very liquid (as governments) to completely un-tradeable
- Liquidity function of size of issue, demand, market makers support, credit quality and whether there is any paper to trade! (Locked away)
- Settlement almost invariably by Euroclear or Clearstream (T+3)
- Variations include dual currency bonds and floating-rate notes

The UK Gilt Market

The Gilt market

- Gilts are UK government debt, the core of the sterling financial markets, benchmark for all borrowing rates
- Gilts are the most secure investment in sterling assets; T-Bills (90-day) are regarded as “risk-free” rate of interest
- About £270 billion nominal outstanding
- Responsibility for issuing gilts now with the Debt Management Office

Gilts (cont.)

Gilt-edged market makers

- Gilts issued through auctions, at which GEMMs will bid for stock (their bids reflect client demand)
- An auction calendar is issued in advance by the DMO
- Maturity breakdown is roughly 45:35:20 shorts:mediums:longs, using BoE and FT definition of shorts, etc

Gilts (cont.) - trading convention

- Price quote is now in decimals, no longer “tick” prices
- Very liquid and transparent market, so bid-offer quote is very narrow
- Daycount convention is now act/act
- Ex-div period is 7 business days before coupon date; no more facility to trade “special ex-div”
- Role of DMO
- Role of BoE

Gilts - settlement

- Settlement through Central Gilts Office, very efficient electronic book-entry transfer system
- Require account at CGO or through agent bank
- Settlement is T+1. “Cash-cash” settlement (same day if before noon) still available
- CGO system uses Delivery by Value mechanism, allowing members to borrow money from other members and pass gilts as collateral
- Merger of CGO, CMO, CREST in June 2000

Gilt Strips

- Strips introduced in December 1997
- Stripping is the process of separating a standard coupon gilt into its constituent coupon and principal payments

  For example, a 10-year gilt can be stripped into 21 zero-coupon bonds, one from the principal repayment and 20 from the semi-annual coupons. Coupon payments due become six, 12, 18 etc month zero-coupon bonds
- Market began quietly - in first month under 1% of strippable stock held in stripped form; turnover under 1% that of coupon gilts

Strips market mechanics

- Strips are fully-fledged gilts
- Stripped and re-constituted via CGO, cannot be held in paper form.
- Coupon strips fully fungible, all have same maturity dates (7 June and 7 December).
- Coupon and principal strips not fungible
- Minimum strippable amount £10,000 nominal, can increase in units of £10,000
- No limit on the amount or proportion of any strippable gilts that can be stripped

Strippable Gilts

Stock	Redemption date	Amount in Issue (£mn)		Amount held in Stripped form (£mn)	
		31/03/98	31/12/98	31/03/98	31/12/98
8% Treasury 2000	07-Dec-00	9,800	9,800	314	110
7% Treasury 2002	07-Jun-02	9,000	9,000	198	211
6 1/2% Treasury 2003	07-Dec-03	2,000	5,446	27	68
8 1/2% Treasury 2005	07-Dec-05	10,373	10,373	304	549
7 1/2% Treasury 2006	07-Dec-06	11,700	11,700	40	170
7 1/4% Treasury 2007	07-Dec-07	11,000	11,000	163	235
5 3/4% Treasury 2009	07-Dec-09	-	5,877	-	67
8% Treasury 2015	07-Dec-15	13,787	13,787	237	254
8% Treasury 2021	07-Jun-21	16,500	16,500	600	583
6% Treasury 2028	07-Dec-28	2,000	5,000	-	199

(Source : DMO)

Pricing Convention

- Strips quoted on yield basis; on average bid-offer spread is 2 basis points*

$$P = \frac{100}{\left(1+\frac{r}{2}\right)^{\frac{d}{s}+n}}$$

r is gross redemption yield,

d is no. of days from settlement date to next quasi-coupon date,

s is number of days in quasi-coupon period in which settlement date falls,

n is number of remaining quasi-coupon periods

* ABN AMRO Salesman!

Stripping and Reconstitution

- Stripping can be carried out only by Bank of England or a gilt-edged market maker
- Non-GEMMs must buy strips in the market or strip a gilt they own via GEMM
- Not available on NSSR; private investors must buy via stockbroker
- GEMM makes request to reconstitute, CGO delivers coupon gilt in exchange for relevant principal strip and correct amount of coupon strips representing the bond's un-matured cash flows

Strips - advantages

- Strips potentially have a large number of uses for investors and traders.
- Simplicity of one cash flow at maturity allows matching to future liabilities
- More precise management of cash flows
- No reinvestment risk, as associated with coupon bonds
- Higher duration and convexity than conventional bonds of same maturity, useful for duration-weighting a portfolio or taking risk positions

  Eg., switching into a position which is duration neutral but picks up yield and convexity

Strips - main uses

- Matching long liabilities (pension funds)
- Matching cash flows

  Eg, insurance companies wishing to match actuary-estimated payments, acquiring forward-starting annuities
- Collateralisation of guarantees

  Eg, financial products with guaranteed return, such as guaranteed equity-linked funds; structured products
- Investing for a known future commitment

  Eg, private investors: pension planning, school fees
- Expressing views on sterling interest rates

Strips - types of investors

- Institutional investors

  Pension funds, insurance companies, cash-rich, natural buyers of long-dated strips
- Banks and building societies

  Short-term cash management, ALM, money market liquidity, guaranteed products
- Central banks

  Short-dated as part of government cash management, dealing for customers
- Money market funds, using short-dated strips (0-3 years) to reduce reinvestment risk

Types of investors (cont.)

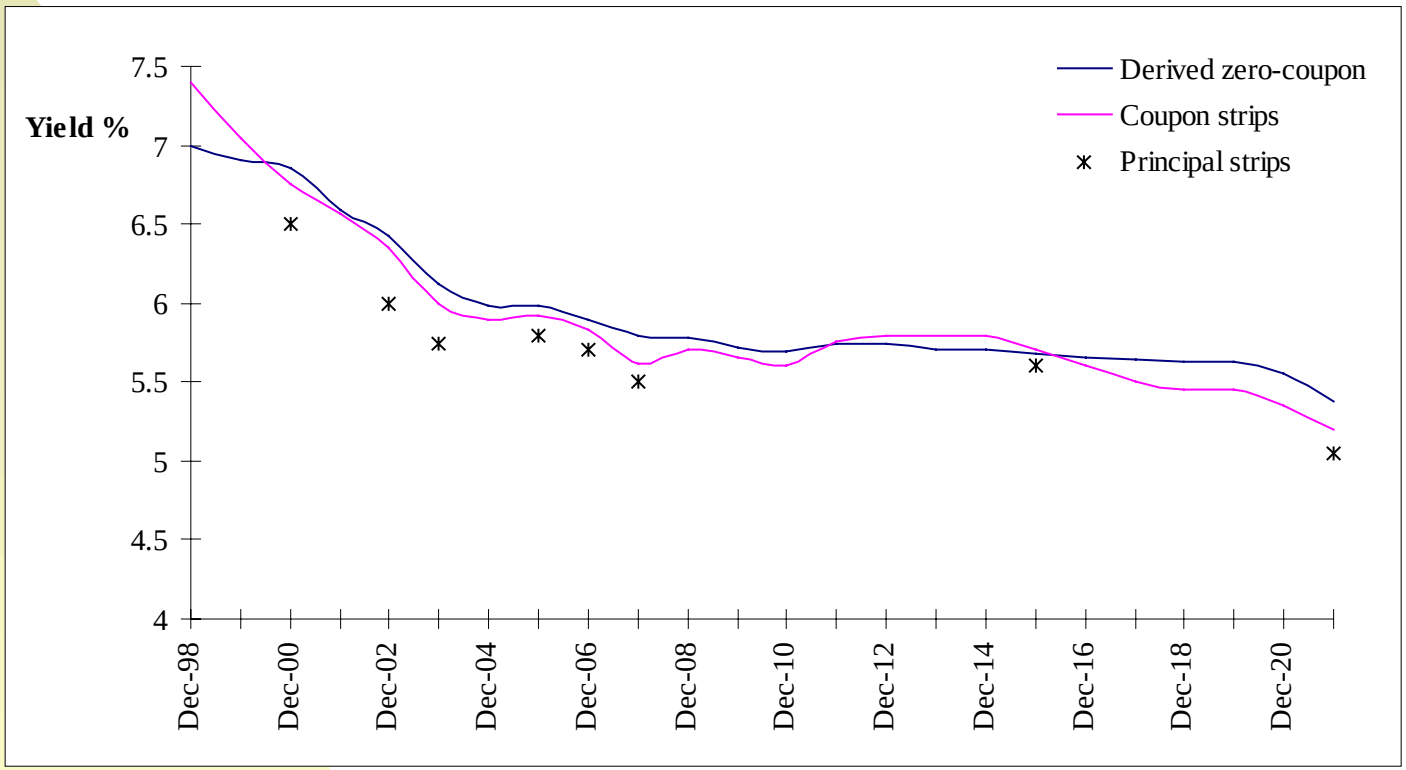
- Corporate treasurers

  Cash management, investment
- Hedge funds

  Trading very long-dated strips to take advantage of high duration and convexity properties
- Foreign investors, expressing view on sterling interest rates
- Private investors

  Mortgage redemption, retirement savings, etc

Strip Yield Curves - January 1998



Source : DMO

Strips- analysis of trading patterns

- Common for observed yield curve to differ from theoretical curve
- Strip yields reflect liquidity considerations; short coupon strips more liquid (greater volume)
- Segmentation effects occur in strips (as in coupon gilts), because demand concentrated at particular points of curve
- Principal strips exist in greater quantity, more liquid and also in greater demand, hence trade at lower yield

Introduction to Repo markets

Repo Markets

- Repo is essentially a secured money market instrument
- Repo traders need to be aware of bond market developments because of the bonds they “trade” as collateral
- Repo desk works closely with other parts of the bank, sits in Treasury or Bond division

Definition of a Repo

- “Repo” comes from “Sale and *Repurchase* Agreement”
- Repo is a money market instrument. There are usually two parties to a repo transaction.
- One party “sells” bonds to the other while simultaneously agreeing to repurchase them or receive them back at a specified future date
- One party requires either the cash or the bonds and provides collateral to the other as well as compensation for the temporary use of the desired asset
- Although legal title to the collateral is transferred, the seller/lender retains both the economic benefits and the market risk of owning them
- If cash is involved the party receiving the cash will pay interest on this cash at the agreed repo rate

Repo Definition (cont.)

Repo is therefore a secured loan

Legally : a sale and repurchase of bonds

Economically : a secured loan of cash

The cash investor receives the repo rate

Advantages for the cash investor :

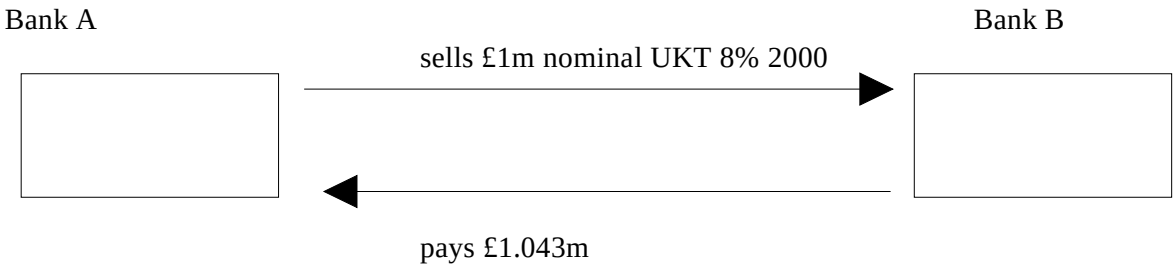
-- secured investment

-- repo rate competitive with bank deposits

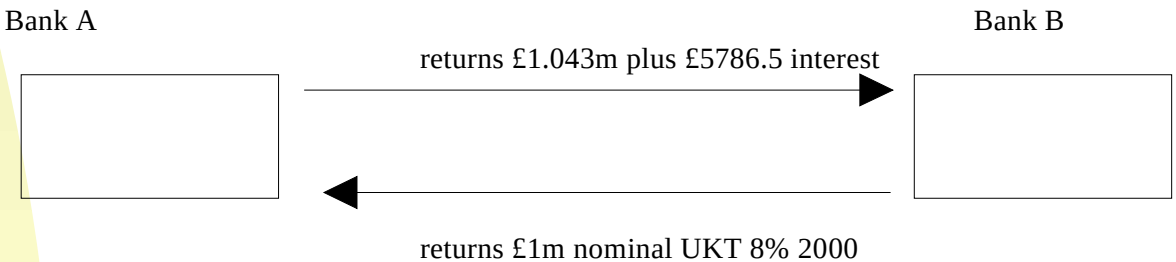
-- diversification away from bank risk

Repo Example

<u>First Leg</u>



<u>Second leg</u>



Classic Repo Example

On 6 September 1997 Bank A agrees to sell £1m nominal of a UK gilt, the 8% Treasury 2000, which is trading at a dirty price of 104.30.

Trade value date is 7 September, term 30 days, matures 7 October and agreed repo rate is 6.75%.

The first leg of the trade Bank A passes over the stock and receives £1.043m

- On 7 October Bank B returns the gilt and Bank A pays over the original monies plus repo interest of £5786.50.

Repo Example (cont.)

- In a classic repo the sale and repurchase prices are the same, although settlement values will differ because of addition of repo interest on termination
- A sale and repurchase is a “repo”, whereas a purchase and sell back is a “reverse repo”. Of course the counterparty is either one or the other, opposite to your position!
- If a coupon is paid during the term of the repo it will be handed over to the seller.
- A classic repo is subject to a legal contract signed in advance by both parties

The Sell / Buy Back

- A sell / buy back is a spot sale and forward repurchase of bonds transacted simultaneously. The repo rate is not explicit but is implied in the forward price
- Coupon payments during the term of the trade are paid to the seller, this is done through incorporation into the forward price so it is not received immediately.
- Generally sell / buy backs are not subject to a legal agreement, so in effect the seller has no legal right to any coupon and there is no provision for *variation margin.*

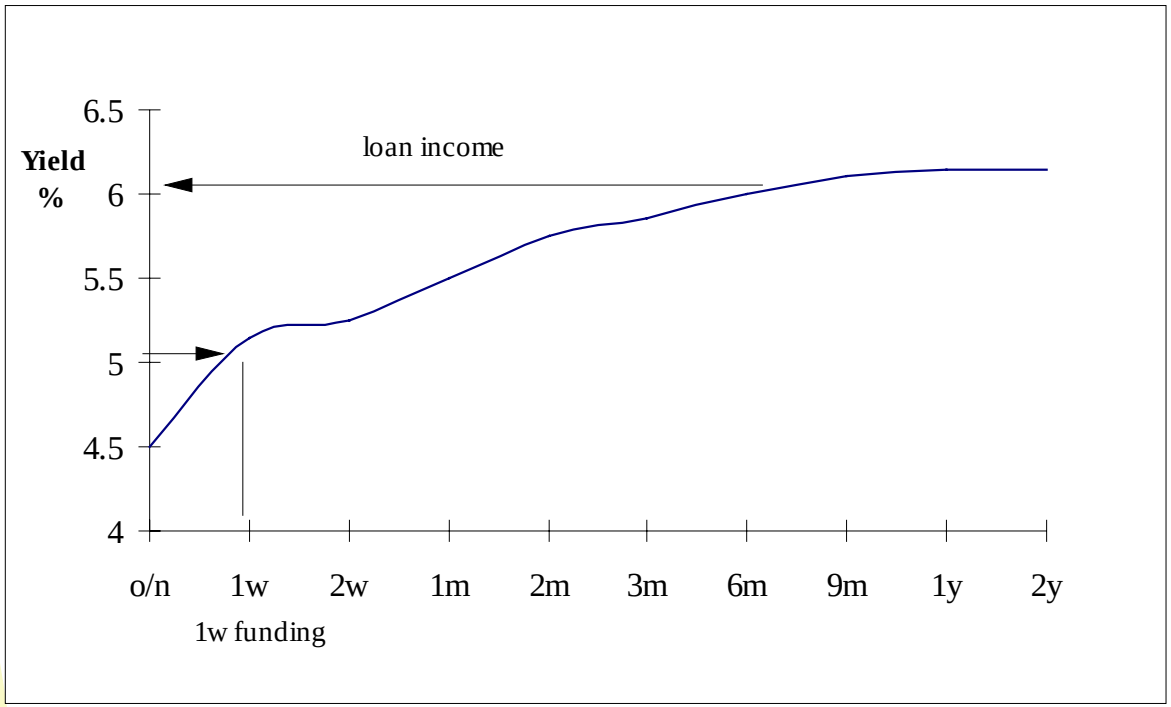
The Sell / Buy Back (cont.)

- The forward bond price is calculated by converting the termination money, that is, dividing the termination money by the nominal value.
- The interest accrued *during the term of the trade* is subtracted from this price to obtain a forward clean price

Stock Lending

- Institutional investors such as pension funds and insurance companies may prefer to enhance income from portfolios by lending bonds, for a fee, rather than through repo
- No requirement for dealing, monitoring and settlement systems as required in repo, and no exposure to interest rate risk
- Less transparent and readily realisable value from “special” stock

Positive Yield Curve Environment

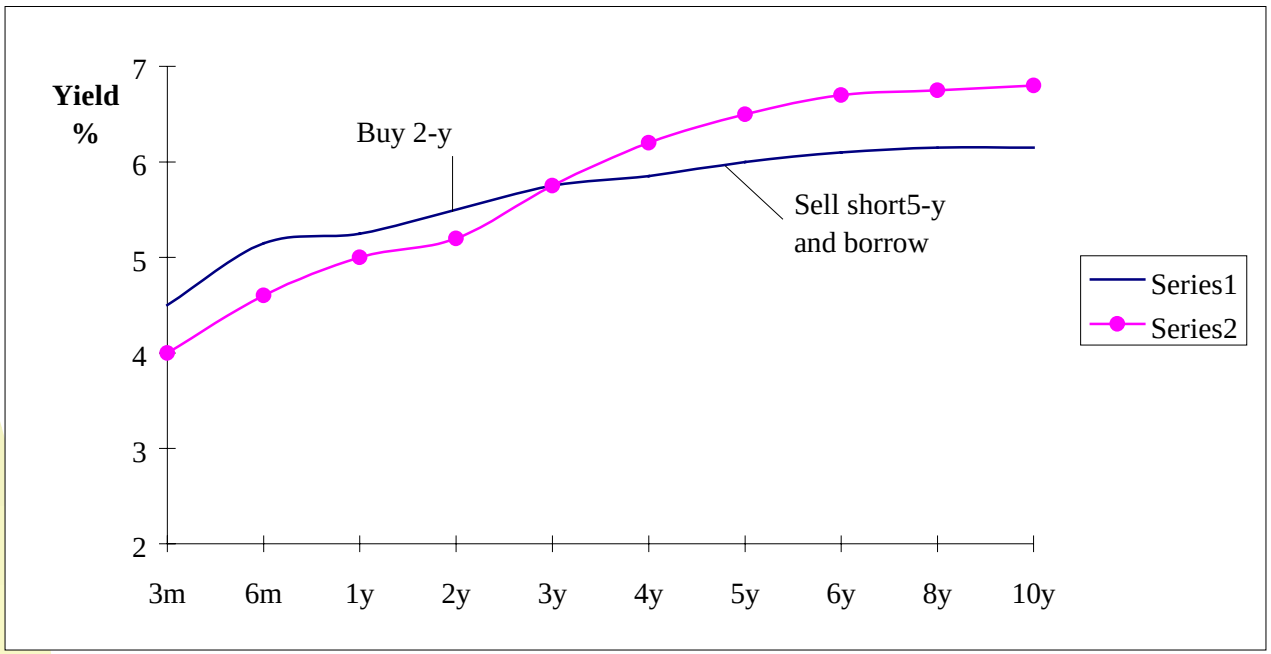


-- Creating a “tail”, funding short

-- Interest rate gap exposure

-- Issues in inverted (negative) yield curve environment ?

Yield Curve Arbitrage



-- Expect yield curve steepening; spread trade 2-yr vs 5-yr

-- “series 1” is shape of curve at start of trade, “series 2” shape of curve at point profit taken and trade unwound

The Money Markets

Money Market Instruments

- Money market instruments have a maturity of less than one year
- Securities quoted on a ***yield*** basis

  Money Market Deposits

  Certificates of Deposit
- Securities quoted on a ***discount*** basis

  Treasury Bills

  Bills of exchange

  Bankers acceptances

  Commercial Paper

Risk Management

Characterising Risk

- Market risk, in bond markets price changes as a result of moves interest rates (“interest rate risk”)
- Credit risk
- Liquidity risk
- Counterparty risk
- Operational risk
- Model risk
- For bonds specifically : reinvestment risk, pre-payment risk

The risk management function

- Market practice now dictates an independent “middle office” risk management function, reporting to group chief exec
- Monitoring separation of duties
- Daily monitoring of risk exposure and p/l
- Monitoring limits and limit utilisation

Value-at-Risk

- Market practice now virtually dictates use of a VaR measurement system to estimate market risk exposure
- Shareholder comfort?
- VaR: a measure of market risk - the maximum loss that can occur (with X% confidence) over a selected holding period of *t* days
- Three methods: variance / covariance (correlation), includes RiskMetrics; historical simulation; Monte Carlo

Bloomberg Screens

Useful Bloomberg screens

- For bond terms and description select page DES
- For yield analysis select YA
- FWCV : forward curve
- BBAM : Libor fixing
- RRRA : repo analysis
- GA1: gap analysis
- The ticker for gilts is UKT; for principal strips is UKTR and coupon strips UKTS

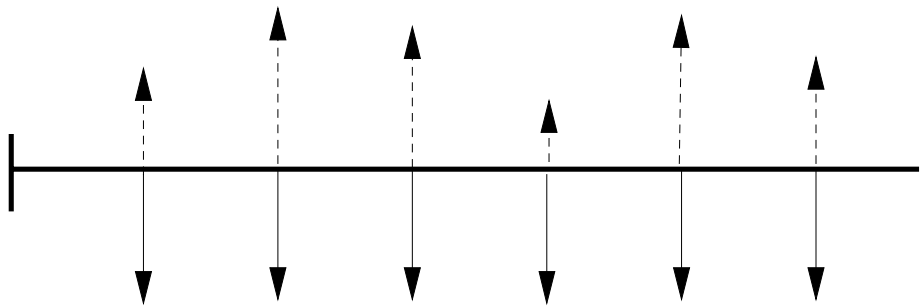
Off-Balance Sheet Instruments

Interest Rate Swaps

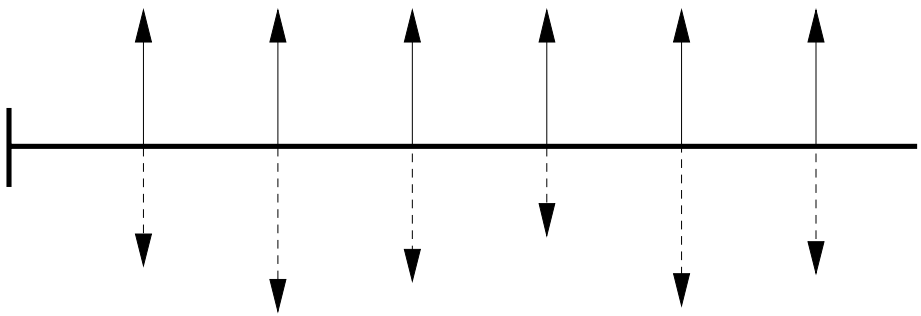
- Swaps are synthetic securities; IR swap is an agreement between two parties to make periodic payments to one another during term of swap, on pre-set dates, based on a *notional* principal amount
- In a vanilla swap, one party makes fixed rate payments and the other makes floating-rate payments
- The principal itself is not exchanged, hence term off-balance sheet instrument

Cash flows in interest rate swap

Fixed rate payer :



Floating rate payer :



Swaps (cont.)

- Swaps are used for many reasons, including changing an interest rate liability from floating to fixed or vice-versa, to hedge an existing position or to exploit comparative advantages to reduce borrowing costs
- Original example:

Futures contracts

- A futures contract is an agreement between two parties fixing terms of an exchange that takes place at a later date
- Exchange-traded standardised contracts (which differentiates it from a forward)
- Financial futures in the UK are traded on LIFFE
- In the sterling markets they include medium-and long-gilt and short sterling contracts
- Also contracts in euro bonds and short euros

Uses of futures

- Speculation; punting on the exchange
- Hedging

  --using the ratio of BPV's futures and bonds to hedge a bond position, calculate number of contracts to buy or sell
- Yield curve trades, using a spread trade or a strip of futures contracts; taking a view on interest rates or shape of the curve

LIFFE long gilt contract

- Notional 10-year gilt, any gilt of 8.75-13 years maturity
- Contract is for £100,000 of gilt
- Contracts expire every March, June, September and December
- Holding a contract to expiry will result in being delivered into; will receive the *cheapest-to-deliver* gilt for that contract
- Basis trading

LIFFE short sterling contract

- A short-term interest rate contract
- Contract a 90-day time deposit of £500,000
- Price quoted as 100 - interest rate; eg price of 96.40 is a 3-mo rate of 3.60%.
- The price of the contract at any time is the market view of where 3-mo rates will be on expiry
- Use contract to hedge or take a view on rates, or lock in an interest rate

American: exercise at any time until expiry

European: can exercise only on expiry date

Call option : right but not obligation to buy the underlying at strike price,

Put option: right but not obligation to sell underlying at strike price

Bond options

- Exchange traded options are usually an option on the bond future
- Can trade an OTC option on the cash underlying
- Use to hedge; eg, a long position can be hedged with bought *put* option or sold *call* option
- Advantage of using options over futures is not locking in a rate; can benefit from a market move in your favour

Emerging Markets

Emerging Bond Markets

- As markets develop, increasing foreign investor interest in capital markets, including bonds
- Attraction of higher yields, just as yields are dropping in developed markets, brought on by eg., Fed performance, EMU convergence, low inflation
- Size of debt markets growing steadily, eg., $100bln in Argentina, $220 bln in Brazil, $60 bln in Russia
- Long dated spreads range from Treasury + 600 in Argentina to + 1150 in Venezuela and + 4140 in Russia (Jan 1999)

Higher level of risk

- Widening spreads reflect highly volatile markets and investor loss of confidence in emerging markets in 1998
- Higher level of risk :

  Counterparty risk

  Market risk, price volatility

  Settlement risk (often domestic market)

  Much higher spreads required

To conclude

- Bond markets are a very important part of world financial markets
- These days it is possible to design an instrument that fits both borrowers and investors needs precisely (although not necessarily the same bond or at the same time!)
- Re-visit objectives