THE INSTITUTE OF CHARTERED ACCOUNTANTS OF SRI LANKA

Corporate Finance and Risk Management
STRATEGIC LEVEL
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BONDS VALUATION

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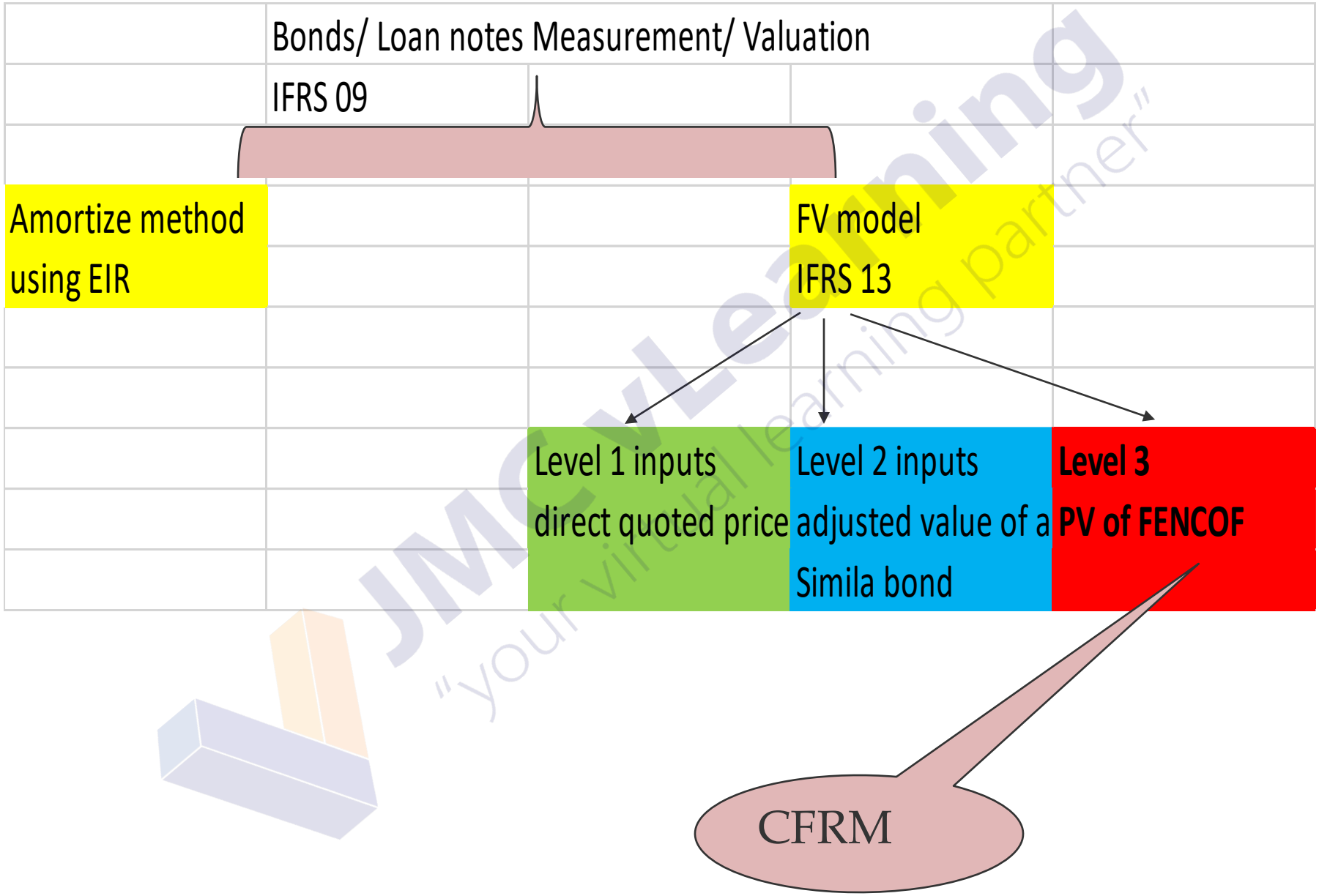
JAYASEKERA MANAGEMENT CENTRE (PVT) LTD. COLOMBO 02. JMC ESTD. 1972


Bonds/ Loan notes Measurement/ Valuation
IFRS 09
Amortize method using EIR
FV model IFRS 13
Level 1 inputs direct quoted price
Level 2 inputs adjusted value of a Simila bond
Level 3 PV of FENCOF
CFRM

Valuation of Bonds and Stock

- First Principles:
  - Value of financial securities = PV of expected future cash flows

- To value bonds and stocks we need to:
  - Estimate future cash flows:

    size (how much) and **timing** (when)
  - Discount future cash flows at an appropriate rate – EIR / IRR of cash flows

Bond Features

- **What is a bond -**
  - debt issued by a **corporation** or a **governmental body**.
  - A bond represents **a *loan*** made by investors to the *issuer.*
  - In return for his/her money, the investor receives a legal claim on future cash flows of the borrower.

- **The issuer promises to:**
  - make regular ***coupon*** payments every period until the bond matures, and
  - pay the ***face (par) value*** of the bond when it matures.

- **Default**
  - an issuer who fails to pay is subject to legal action on behalf of the lenders (bondholders).

Zero Coupon Bonds	❑ No annual interest receipt ❑ Principle will pay at the redemption with a premium
Irredeemable Bonds	❑ annual interest receipt – PV of Perpetuity (r/Kd) ❑ Principle wont pay
Redeemable Bonds	❑ annual interest receipt ❑ Principle will pay

Pure-Discount (Zero-Coupon) Bonds

- Information needed for valuing pure discount bonds:
  - Time to maturity (T):

    T = Maturity date - today's date
  - Face value (F)
  - Discount rate (r)

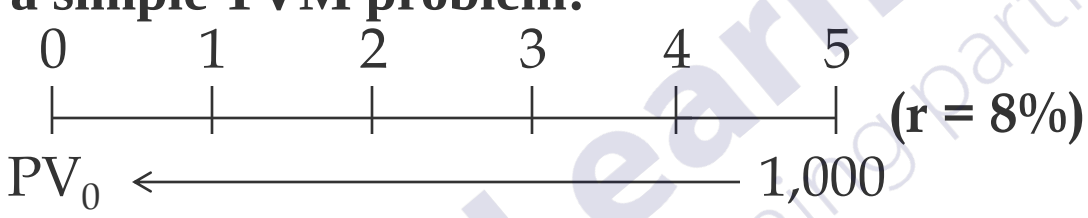
- Value of a pure discount bond:

$$PV = F / (1 + r)^n$$

Examples - Pure Discount Bonds

Q1. Consider a zero-coupon bond, with a face value of $1,000, maturing in 5 years. Suppose that the appropriate discount rate is 8%. What is the current value of the bond?

A1. **This is a simple TVM problem:**



Use the above PV equation to solve:

$PV = F / (1 + r)^T = 1{,}000 / (1.08)^5 =$ **$ 680.58 – mkt value**

Q2. Suppose 6 months have past. What is the bond value now?

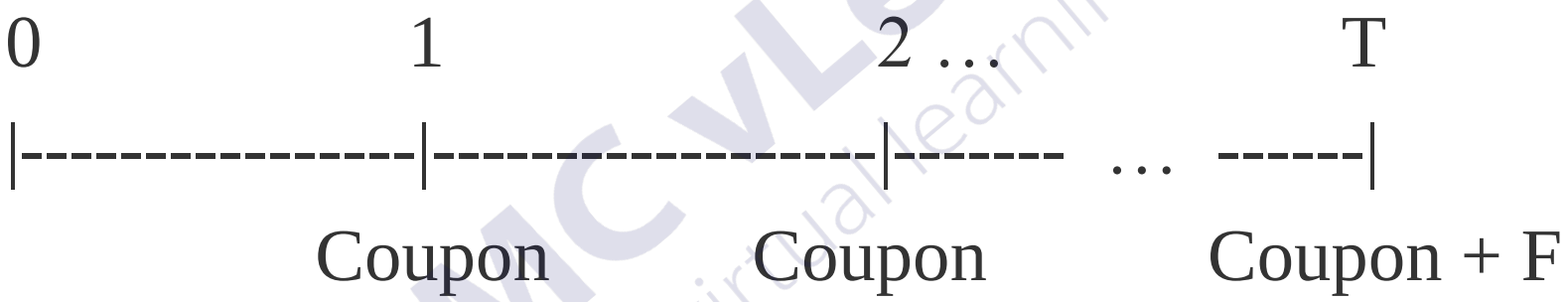
A1. Again, use the above PV equation to solve:

$PV = F / (1 + r)^T = 1{,}000 / (1.08)^{4.5} =$ **$ 707.28**

Note: As we get closer to maturity(T), the z.c. bond value increases (PVm), since we have to wait less time to receive $1,000

Level-Coupon Bonds – With annual Interest

- Information needed to value level-coupon bonds:
  - Coupon payment dates and Time to maturity (T)
  - Coupon (C) per payment period and Face value (F)
  - Discount rate



- Value of a Level-coupon bond:

  PV= PV of coupon payments + PV of face value

Example - Coupon Bonds

Q1. Consider a coupon bond paying a 4% coupon rate annually, with a face value of $1,000, maturing in 10 years. Suppose that the appropriate discount rate is 6%.

What is the current value of the bond?

market value of the bond:

1 -10 interest	**– 40**	**x CDCF 7.36**	**= 294.4**
10 principle	**- 1000**	**x**	**0.558**	**=**	**558.0**
					852.5

Example - Discount, Premium and Par Bonds

Q2. **For the above coupon bond:** when discount rate is 6% and coupon rate is 4% (***c*** **< r**), the value of the bond is $852.80, less than its face value (**PV < F**). In this case we say that the bond is priced at **discount**. Recalculate the PV of the above bond with discount rates of 2% and 4%.

A2. **r = 2%**

We have: r = 2% < 4% = *c*.

Use the above PV equation to solve:

$$PV = C\left(\frac{1}{r}\right)\left\{1 - \left[1 / (1 + r)^{T}\right]\right\} + F/(1 + r)^{T}$$

$$= 40\left(\frac{1}{0.02}\right)\left\{1 - \left[1 / (1.02)^{10}\right]\right\} + 1{,}000/(1.02)^{10} = \mathbf{\$1{,}179.65}$$

We see that when ***c*** **> r**, the bond is priced at **premium** (**PV > F**).

r = 4%

We have: r = *c* = 4%.

Use the above PV equation to solve:

$$PV = 40\left(\frac{1}{0.04}\right)\left\{1 - \left[1 / (1.04)^{10}\right]\right\} + 1{,}000/(1.04)^{10} = \mathbf{\$1{,}000}$$

We say that when ***c*** **= r**, the bond is priced at **par** (**PV = F**).

Q3.
SP Co has in issue 12% bonds with par value Rs. 100,000 and redemption value Rs. 110,000, with interest payable quarterly. The market yield on bonds is 8% annually and 2% quarterly. The bonds are redeemable on 30 June 20X4 and it is now 31 December 20X0.

Required
Calculate the market value of the bonds.

Q4.
A five-year unsecured bond with a coupon of 5% per annum, redeemable at par has just been issued. Given the issuer's credit rating, a yield of 6% would be expected. The bond is now trading at Rs. 94 which is a 6% discount on its par value of Rs. 100.

Required
(a) Calculate the value of the bond based on a required yield of 6%? 96/-
(b) What is the yield to maturity based on the current market price? 6.5%
(c) State whether the bond is undervalued or overvalued and state whether the yield on the bond is higher or lower than required by the investor.

Some Tips on Bond Pricing

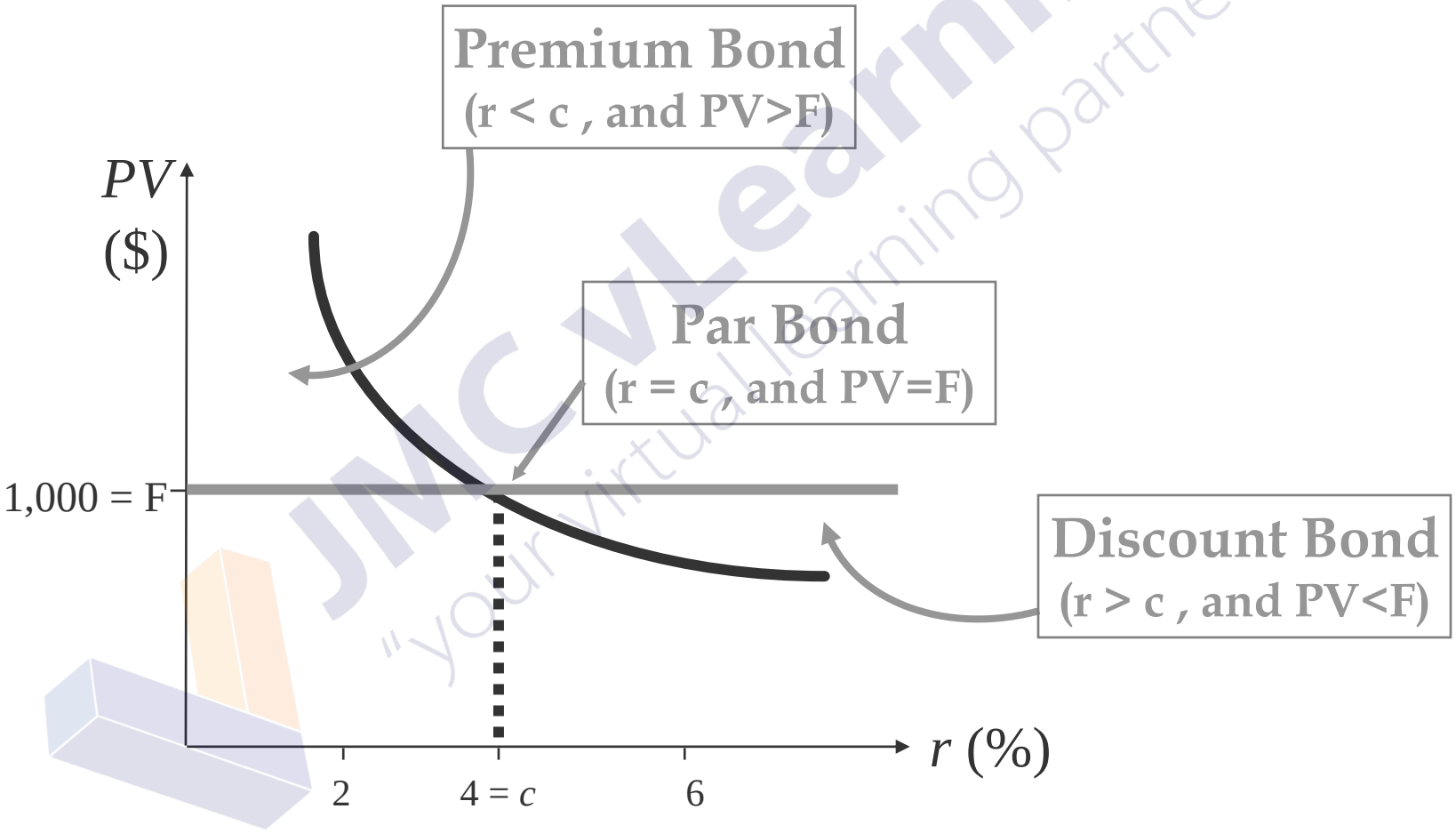
- Bond prices and market interest rates move in opposite directions.

-
  - When coupon rate = market rate (r)
    price = par value.
    (par bond)
  - When coupon rate > market rate (r)
    price > par value
    (premium bond)
  - When coupon rate < market rate (r)
    price < par value
    (discount bond)

Q1.
A five-year unsecured bond with a coupon of 5% per annum, redeemable at par has just been issued. Calculate the value of the bond if the required yield is:
(a) 3% = 109
(b) 5% = 100 par bond
(c) 7% = 92

When Required Yield = Coupon rate par bond
When Required Yield < Coupon rate premium bond
When Required Yield > Coupon rate discount bond

Discount, Premium, and Par Bonds



Yield-To-Maturity (IRR of the Cash Flows)

Meaning

The yield to maturity (or **redemption yield**) is the effective yield on a redeemable bond which allows for the time value of money and is effectively the **internal rate of return** of the cash flows. It represents the return that an investor will receive for buying the bond today.

Example: Yield to Maturity

For example, a five-year unsecured bond with a coupon of 5% per annum, redeemable at par and issued at a 6% discount to par will have a yield to maturity of 6.47%. This is calculated by assuming a nominal value of Rs. 100 and calculating NPVs at 5% and 7% discount rates.

Yield to Maturity for irredeemable debt

For **irredeemable** debt, the yield to maturity (YTM) can be calculated using the perpetuity formula

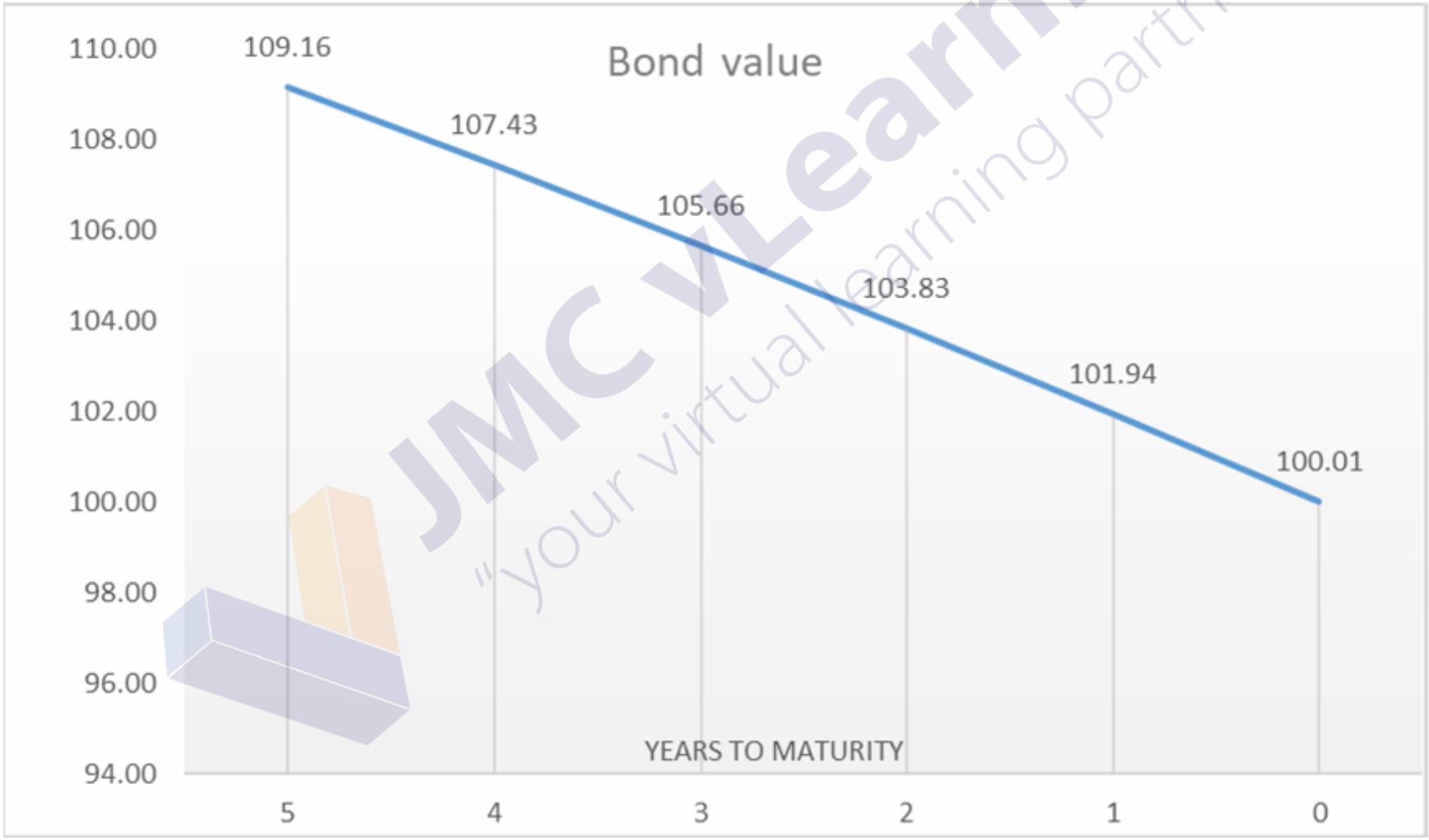
YTM = (Annual interest/Current market value) × 100%
For example, an irredeemable bond with a coupon of 4% and a current market

price of Rs. 93 has a YTM of:
4/93 × 100% = 4.30%

Approaching maturity

As maturity date gets closer, the value of a bonds moves towards its par value.

A chart has been shown for the bond described in the example above, where the required yield is 3%. The value of the bond has been recalculated for each year up to maturity. It can be seen that as maturity gets closer, the value of the bond moves towards par in a linear fashion, and reaches par at the redemption date.



Duration

Duration (also known as Macaulay duration) is the weighted average length of time to the receipt of a bond's benefits (coupon and redemption value), the weights being the present value of the benefits involved.

What is duration?

Duration is the average time taken to recover the cash flow from an investment.
For investments in bonds, maturity is not only affected by the maturity date of the investment but also by the coupon rate (which determines the interest payments).
Duration is useful in allowing bonds of different maturities and coupon rates to be compared.
Duration gives each bond an overall **risk weighting** that allows two bonds to be compared. In simple terms, it is a **composite** measure of the risk expressed in years.

Duration is the **weighted average** length of time to the receipt of a bond's **benefits** (coupon and redemption value), the weights being the **present value** of the benefits involved.

Example Calculating duration

Magic Inc has a bond (Bond X) in issue which has a nominal value of Rs. 1,000 and is redeemable at par.

Bond X is a 6% bond maturing in 3 years' time and has a gross redemption yield (GRY) of 3.5%. The current price of the bond is Rs. 1,070.12.

Required

Calculate the duration of the bond.

period

	1	*2*	*3*	*Total*
Cash flow	60	60	1,060	
Discount factor (3.5%)	0.966	0.934	0.902	
Present value	58	56	956	1,070
% present value in each year	58/1070 = 5.42%	56/1070 = 5.23%	956/1070 = 89.35%	
× by year	5.42/100 × 1= 0.0542	5.23/100 × 2 = 0.1046	89.35/100 × 3 = 2.6805	

Duration = 0.0542 + 0.1046 + 2.6805 = approximately 2.84 years

Properties of duration

The basic features of sensitivity to interest rate risk will all be mirrored in the duration calculation.

(a) **Longer-dated bonds** will have longer durations.
(b) **Lower-coupon bonds** will have longer durations. The ultimate low-coupon bond is a zero-coupon bond where the duration will be the maturity.
(c) **Lower yields** will give longer durations. In this case, the PV of flows in the future will rise if the yield falls, extending the point of balance, therefore lengthening the duration.

The duration of a bond will shorten as the life span of the bond decays. However, the rate of decay will not be at the same rate. In our example above, a 3-year bond has a duration of 2.84 years. In a year's time the bond will have a remaining life of 2 years and a duration based on the same GRY of 1.94 years. The life span has decayed by a full year, but the duration by only 0.9 years.

	1	*2*	*Total*
Cash flow	60	1060	
Discount factor (3.5%)	0.966	0.934	
Present value	58	990	1,048
% present value in each year	58/1048 = 5.53%	990/1048 = 94.47%	
× by year	5.53/100 × 1= 0.0553	94.47/100 × 2 = 1.889	

Duration = 0.0553 + 1.889 = 1.94 years

Modified duration

Modified duration is a measure of the sensitivity of the price of a bond to a change in interest rates.
Rather than looking at the weighted average time it takes to receive the bond's benefits, modified duration measures how sensitive the price of the bond is to a change in the interest rate.

FORMULA TO LEARN

$$\text{Modified duration} = \frac{\text{Macaulay duration}}{1 + \text{GRY}}$$

Using the above example on duration, the modified duration of the bond is:

$2.84/(1 + 0.035) = 2.74$

This can be used to determine the proportionate change in bond price for a given change in yield as follows.

$$\frac{\Delta P}{P} = -\text{Modified duration} \times \Delta Y$$

which can also be expressed as:

$$\Delta P = -\text{Modified duration} \times \Delta Y \times P$$

Where:

ΔP = change in bond price P = current market price of the bond

ΔY = change in yield

Remember there is an **inverse relationship** between yield and bond price, therefore the modified duration figure is expressed as a negative number.

If, in the above example, the yield increased by 0.5%, the change in price can be calculated as follows.

$\Delta P = -2.74 \times 0.005 \times$ Rs. 1,070.12 = Rs. (14.66)

Thus for a 0.5% increase in yield, the bond price will fall by Rs.14.66.

The benefits and limitations of duration

Benefits

The main **benefits** of duration are as follows:

(a) Duration allows bonds of **different maturities** and **coupon rates** to be directly compared. This makes decision making regarding bond finance easier and more effective.

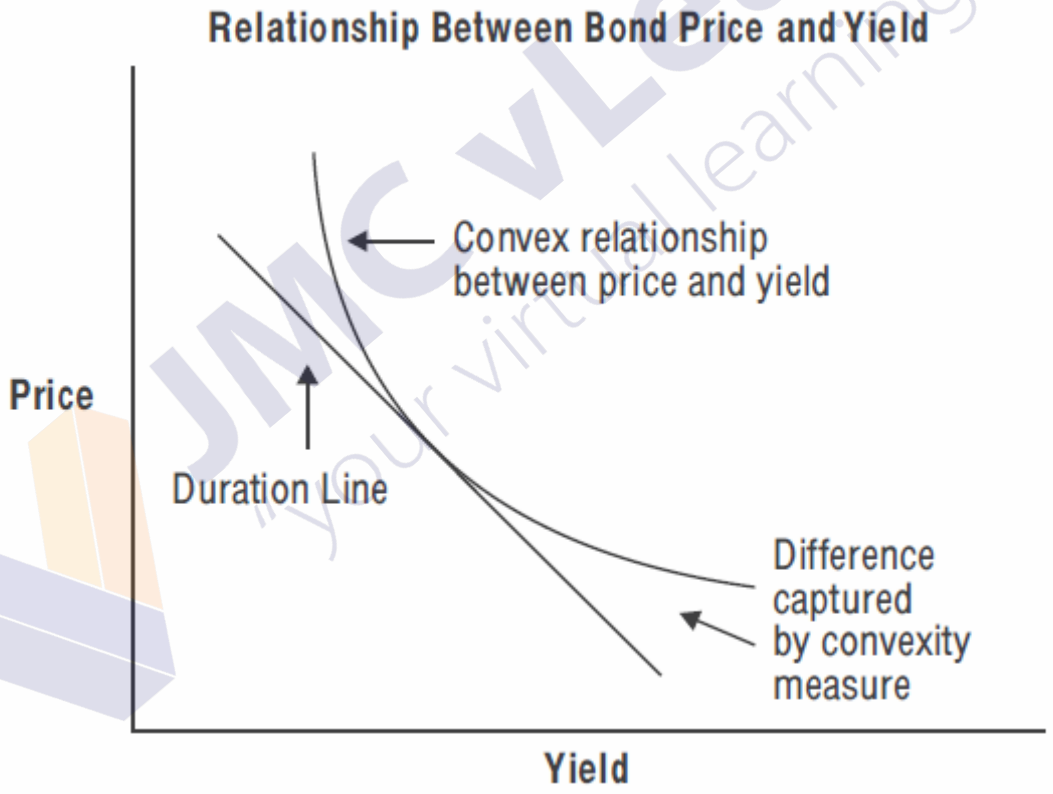
(a) If a bond portfolio is constructed based on weighted average duration, it is possible to determine portfolio value changes based on estimated changes in interest rates.

(a) Managers may be able to modify interest rate risk by changing the duration of the bond portfolio – for example, by adding shorter maturity bonds or those with higher coupons (which will reduce duration), or by adding longer maturity bonds or those with lower coupons (which will increase duration).

Limitations

The main limitation of duration is that it **assumes a linear relationship** between interest rates and price – that is, it assumes that for a certain percentage change in interest rates there will be an equal percentage change in price.

However, as interest rates change the bond price is unlikely to change in a linear fashion. Rather, it will have some kind of convex relationship with interest rates (see below).



As you can see from the diagram above, the more convex the relationship, the more inaccurate duration is for measuring interest rate sensitivity. Therefore duration should be treated with caution in your predictions of interest rate/price relationships.

Duration can only be applied to measure the approximate change in bond price due to changes in interest rates if the interest rate change does not lead to a change in the shape of the yield curve. This is because it is an average measure based on the GRY (yield to maturity).

However, used in conjunction with each other, convexity and duration can provide a more accurate approximation of the percentage change in price resulting from a percentage change in interest rates. It can also be used to compare bonds with the same duration but different levels of convexity. For example, if Bond X has a higher convexity than Bond Y, its price would fall by a lower percentage in the event of rising interest rates.

RISK associates with bonds (ECL= LGD x PD)

Credit risk

Credit risk, also referred to as **default risk**, is the risk undertaken by the lender that the borrower will default either on **interest payments** or on the **repayment of principal** on the due date, or on both.

Credit risk aspects

Credit risk arises from the inability of a party to fulfil its obligation under the terms of a contract. Creditors to companies, such as corporate bondholders and banks, are also exposed to credit risk. The credit risk of an individual loan or bond is determined by the following two factors.

The probability of default

This is the probability that the borrower or counterparty will default on its contractual obligations to repay its debt.

The recovery rate

This is the fraction of the face value of an obligation that can be recovered once the borrower has defaulted. When an company defaults, bondholders do not necessarily lose their entire investment. Part of the investment may be recovered depending on the **recovery rate**.

The loss given default (LGD) is the difference between the **amount of money owed** by the borrower less the **amount of money recovered**.

For example, a bond has a face value of $100 and the recovery rate is 80%. The **LGD** in this case is:

LGD = $100 – $80 = $20

The **expected loss** (EL) from credit risk shows the amount of money the lender should expect to lose from the investment in a bond or loan with credit risk.

The **EL** is the product of the **LGD** and the **probability of default** (PD).

EL = PD × LGD

If the PD is, say, 10%, the EL from investing in the above bond is:

EL = 0.10 × 20 = $2

Credit risk measurement

The measurement of **credit risk** is fairly complex. All the approaches concentrate on the estimation of the **default probability** and the **recovery rate**.

The oldest and most common approach is to assess the probability of default using financial and other information on the borrowers and assign a rating that reflects the EL from investing in the particular bond. This assignment of **credit risk ratings** is done by **credit rating companies**,
such as Standard & Poor,
Moody's Investor Services and
Fitch.

These ratings are widely accepted as indicators of the credit risk of a bond. The table below shows the credit rating used by Moody's and Standard & Poor.

Credit risk rating

Standard & Poor	Moody's	Description of category
AAA	Aaa	Highest quality, lowest default risk
AA	Aa	High quality
A	A	Upper medium grade quality
BBB	Baa	Medium grade quality
BB	Ba	Lower medium grade quality
B	B	Speculative
CCC	Caa	Poor quality (high default risk)
CC	Ca	Highly speculative
C	C	Lowest grade quality

For Standard & Poor's ratings, those ratings from 'AA' to 'CCC' may be modified by the addition of a plus (+) or minus (–) sign to show relative standing within the major rating categories. For example, a company with BB+ rating is considered to have a better credit rating than a company with a BB rating, although they are in the same major rating category.

With Moody's, numerical modifiers 1, 2 and 3 are added to each ratings category from Aa to Caa, with 1 indicating a higher ranking within the category.
For example, a rating of Baa1 is higher than Baa2.

Both credit rating agencies estimate default probabilities from the **empirical performance** of issued **corporate bonds** of each category. The table below shows the probability of default for certain credit categories over different investment horizons. The probability of default within a year for AAA, AA, or A bonds is

practically zero whereas for a CCC bond it is 26.38%. However, although the probability of default for a AAA company is **practically zero** over a single year, it becomes 0.98% over a 15-year period (this is consistent with the theory that, the longer the time horizon, the riskier the investment).

Standard & Poor's cumulative default probabilities (Standard & Poor's, 2015)

Initial rating Term	1	5	10	15
AAA	0.00%	0.36	0.74	0.98
AA	0.02%	0.35	0.82	1.19
A	0.07%	0.57	1.51	2.32
BBB	0.20%	1.95	4.06	5.84
BB	0.76%	7.71	13.74	16.77
B	3.88%	18.70	25.91	29.49
CCC	26.38%	46.28	450.73	53.38

Criteria for establishing credit ratings

The criteria for rating international organisations encompasses the following:

Country risk	No issuer's debt will be rated higher than the country of origin of the issuer (the 'Sovereign Ceiling' concept)
Universal/Country importance	The company's standing relative to other companies in the country of domicile and globally (measured in terms of sales, profits, relationship with government, importance of the industry to the country, etc)
Industry risk	The strength of the industry within the country, measured by the impact of economic forces, cyclical nature of the industry, demand factors, etc
Industry position	Issuer's position in the relevant industry compared with competitors in terms of operating efficiency

Management evaluation	The company's planning, controls, financing policies and strategies, overall quality of management and succession, merger and acquisition performance and record of achievement in financial results
Accounting quality	Auditor's qualifications (if any) of the accounts, and accounting policies for inventory, goodwill, depreciation policies and so on
Earnings protection	Earnings power including return on capital, pre-tax and net profit margins, sources of future earnings growth
Financial gearing	Long-term debt and total debt in relation to capital, gearing, nature of assets, off balance sheet commitments, working capital, management, etc
Cash flow adequacy	Relationship of cash flow to gearing and ability to finance all business cash needs.
Financial flexibility	Evaluation of financing needs, plans and alternatives under stress (ability to attract capital), banking relationships, debt covenants.

Credit migration

The credit rating of a borrower may change after a bond is issued. This is referred to as credit migration.

There is another aspect of **credit risk** which should be taken into account when investors are investing in **corporate bonds**, beyond the **probability of default**.
A borrower may not default, but due to changing economic conditions or management actions the borrower may become more or less risky than at the time the bond was issued and, as a result, the bond issuer will be assigned a different credit rating by the credit agency. This is called **credit migration**. The significance of credit migration lies in the fact that the assignment of a **lower credit rating** will **decrease the MV** of the corporate bond. This is discussed in the next section in the context of credit spreads.

Reducing credit risk – credit enhancement

Credit enhancement is the process of reducing credit risk by requiring collateral, insurance or other agreements to provide the lender with reassurance that it will be compensated if the borrower defaulted.

Credit enhancement is a key part of the securitisation transaction in structured finance and is important for credit rating agencies when raising a securitisation.

Internal credit enhancement /reduce credit risk

There are two main types of internal credit enhancement – excess spread and over-collateralisation.

Excess spread

Another name for excess spread is 'excess interest cash flow'. It is the difference between interest received by issuers of asset-based securities (such as mortgages) on the securities sold and the interest paid to the holders of these securities. One example is sub-prime mortgages. Such mortgages are sold at a higher rate of interest than prime mortgages, resulting in higher interest receipts for the mortgage providers.

Over-collateralisation

Over-collateralisation is a common form of credit enhancement. In simple terms, it is the **ratio of assets to liabilities**. Over-collateralisation occurs when the value of the assets held to support a security is actually greater than the security itself (the ratio of assets to liabilities is greater than 1). This gives the holder of the assets a 'cushion' in the event of late or non-payment from the security.

How the level of over-collateralisation is determined can be illustrated using an example from Standard & Poor's. A cash flow transaction involves the issue of $80 million of senior debt which is supported (backed) by a collateral pool of assets which has a par value of $100 million (known as an 80/20 liability structure). The level of over-collateralisation is the ratio of assets to liabilities – that is, $100 million/$80 million or 125%.

External credit enhancement

External credit enhancement tools include surety bonds, letters of credit and cash collateral accounts.

Surety bond

A **surety bond** is a guarantee to pay a loss sustained as a result of a breach of contractual or legal obligations. Strictly speaking, a surety bond is a **contract of guarantee**, not of insurance and involves three persons: the **contractor**, who puts the bond in place, the **employer**, who is contracting with the contractor and requires the surety bond to be provided, and the **guarantor**, who may be an insurer. In the event of the contractor's default, the guarantor compensates the employer for any losses incurred. Often the guarantor provides its guarantees only to securities already of at least investment-grade quality (that is, BBB/Baa or equivalent).

Letter of credit

A financial institution (typically a bank) which issues a letter of credit is **obliged** to reimburse any losses incurred up to the required credit-enhancement amount, in return for a fee.

Letters of credit are **often used in international trade** to protect both the importer and exporter. A letter of credit represents a written undertaking given by a bank on behalf of an importer to pay a specified sum of money to the exporter within a certain time. However, in order to be entitled to the payment the exporter must be able to produce necessary documentation that complies with the terms stated in the letter of credit.

In the early 1990s, the long-term debt of some of the banks responsible for issuing letters of credit was **downgraded**, which lessened the appeal of these tools.

Cash collateral account

A **cash collateral account** is an account that is used to secure and service a loan. Deposits are made into this account but no sums can be withdrawn. When funds are paid in and have cleared, this reduces the loan which is served by this account. As no sums can be withdrawn, it is viewed as a zero-balance account – any money that is paid in goes immediately towards reducing the extent of the loan being served.

As a cash collateral account is an actual deposit of cash, a downgrade of the account provider would not result in a similar downgrade of the security (unlike letters of credit and surety bonds).

Credit spreads

The **credit spread** is the premium required by an investor in a corporate bond to compensate for the **credit risk** of the bond.
The yield to a government bondholder is the compensation to the investor for forgoing consumption today and saving. However, corporate bondholders should require compensation not only for forgoing consumption but also for the credit risk that they are exposed to. As we discussed in the previous section, this is a function of the probability of default, the recovery rate and the probability of migration. Assuming that a government bond such as the one issued by the US or an EU Government is **free** of **credit risk**, the yield on a corporate bond will be:

Yield on corporate bond = risk free rate + credit spread

Since **credit spreads** reflect the **credit risk** of a bond, they will be inversely related to the credit quality of the bond. **Low credit quality** bonds will be characterised by **large spreads** and **high credit quality** bonds will be characterised by **low spreads**. An example of credit spreads by type of bond and maturity is given below.

Reuters Corporate Spreads for Industrials (in basis points)

Rating	1 year	2 year	3 year	5 year	7 year	10 year	30 year
AAA	5	10	12	18	28	42	65
AA	11	20	27	37	45	57	82
A	33	47	55	67	76	84	112
BBB	47	95	109	127	139	152	191
BB	240	265	283	304	321	339	377
B	456	482	505	531	555	581	616
CCC+	600	626	653	682	712	743	775

(bondsonline.com, 2014)

Example

The current return on a 10-year government bond is 4.2%. Roger Inc, a company rated AA, has 10-year bonds in issue. Using the credit spread table above, calculate the expected yield on Roger Inc's bonds.

ANSWER

The credit spread on a 10-year AA bond is 57, which means that 0.57% should be added to the return on the government bond.

Expected yield on Roger Inc's bonds = 4.2% + 0.57% = 4.77%

Example (2)

A 15-year government bond has a current yield of 5%. Dibble Inc, a B rated company, has equivalent bonds in issue. What is the expected yield on Dibble Inc's bonds?

Solution

The table does not include credit spreads for 15-year bonds therefore some adjustment is required to the figures we have available.

The credit spread on a 10-year B rated bond is 581 and a 30-year B rated bond is 616. The adjustment can be calculated as follows.

$$581 + \frac{(616 - 581)}{(30 - 10)} \times 5 = 590$$

This means that 5.9% must be added to the yield on government bonds.

The expected yield on Dibble's bonds is therefore 5% + 5.9% = 10.9%

The cost of debt capital

The cost of debt capital for a company is determined by the following.
(a) Its credit rating
(b) The maturity of the debt
(c) The risk-free rate at the appropriate maturity
(d) The corporate tax rate

FORMULA TO LEARN

$$\text{Cost of debt capital} = (1 - \text{tax rate})(\text{risk-free rate} + \text{credit spread})$$

QUESTION — Cost of capital

Jolly Inc, a BBB rated company, has 5-year bonds in issue. The current yield on equivalent government bonds is 3.7% and the current rate of tax is 28%.

Required

Using the information in the credit spread table above, calculate:

(a) The expected yield on Jolly Inc's bonds

(b) Jolly Inc's post-tax cost of debt associated with these 5-year bonds

ANSWER

(a) Expected yield on 5-year bonds = 3.7% + 1.27% = 4.97%

(b) Post-tax cost of debt = (1 – 0.28) × 4.97 = 3.58%

Impact of credit spreads on bond values

The deterioration in the credit quality of a bond, referred to as credit migration, will affect the MV of the bond.

We have already mentioned that credit risk is affected by the probability of migration of a certain debt or loan to another credit category. In markets where loans or corporate bonds are traded this migration is reflected in increased spreads. Using only the probability of default and ignoring the probability of migration from one category to another may give a misleading estimate of the risk exposure. Thus a company that has a very low or even zero probability of default but a high probability of being downgraded will have its credit risk significantly underestimated.

To explain how credit migration may impact on bond values, consider a bond which is currently rated as BBB. In a year's time the bond may still be rated BBB, or it may have a higher or lower credit rating. An indication of the probability of being at the same or a different rating in a year's time is reproduced in the table below.

Value of BBB bond for different credit ratings

Year-end rating	Probability of migration
AAA	0.02%
AA	0.33%
A	5.95%
BBB	86.93%
BB	5.30%
B	1.17%
CCC	0.12%
Default	0.18%

As we have discussed, each credit category implies a different credit spread which in turn implies a different cost of debt capital. The table below is an example of the cost of debt capital for bonds of different credit ratings and different maturities. The cost of debt capital for an AAA bond with a maturity of one year is 3.6%, whereas the cost of capital for a CCC bond with a maturity of four years is 13.52%.

Yields by credit category (%)

Category	Year 1	Year 2	Year 3	Year 4
AAA	3.60	4.17	4.73	5.12
AA	3.65	4.22	4.78	5.17
A	3.72	4.32	4.93	5.32
BBB	4.10	4.67	5.25	5.63
BB	5.55	6.02	6.78	7.27
B	6.05	7.02	8.03	8.52
CCC	15.05	15.02	14.03	13.52

Source: CreditMetrics Manual

The value of a bond is the **PV** of the coupons and the redemption value, **discounted** using the appropriate cost of debt capital.

For the BBB bond of our example we need to assume a coupon rate and a face value. Suppose the bond has a face value of $100 and pays an annual coupon of 6%. Using the discount factors from the table above we calculate the value of the bond at the end of a year if it remained rated BBB using:

$$P_{BBB} = \frac{6}{1.041} + \frac{6}{(1.0467)^2} + \frac{6}{(1.0525)^3} + \frac{106}{(1.0563)^4} = 101.53$$

If it is upgraded to A, it will be worth $102.64.

$$P_A = \frac{6}{1.0372} + \frac{6}{(1.0432)^2} + \frac{6}{(1.0493)^3} + \frac{106}{(1.0532)^4} = 102.64$$

If it is downgraded to CCC, it will be worth $77.63.

$$P_{ccc} = \frac{6}{1.1505} + \frac{6}{(1.1502)^2} + \frac{6}{(1.1403)^3} + \frac{106}{(1.1352)^4} = 77.63$$

Calculating the values of the BBB bond for all possible ratings results in the values that are shown in the table below.

Value of BBB bond for different credit ratings

Year-end rating	bond value
AAA	$103.35
AA	$103.17
A	$102.64
BBB	$101.53
BB	$96.01
B	$92.09
CCC	$77.63

The value of the bond when it defaults will not be zero, as the issuing firm will have some assets. The available empirical evidence from credit rating agencies shows that about 51% of the value of a BBB bond is recovered when the issuing firm defaults.

If bondholders expect to recover in case of bankruptcy, the non-recoverable amount is \$49 per \$100 of face value. The LGD for a BBB bond will therefore be:

$$LGD = 0.49 \times 100 = \$49$$

The EL for the BBB bond in the example is:

$$EL = 0.0018 \times \$49 = \$0.0882$$

The low probability of default reduces the credit risk of a BBB bond despite the fact that it loses nearly 50% of its value in the case of a default.

Yields on different bonds

In July 2019, the US government bonds were rated AA+ by Standard & Poor's, which is 1 grade below the top rating of AAA. Canadian government bonds enjoyed the top rating of AAA. The yield on US 10 year bonds was around 2.05% compared to 1.58% for Canadian government 10 year bonds.
Standard & Poor's rating for Sri Lankan government bonds are currently rated B with a comment that the "outlook is stable". At the time of writing (July 2019) new 10 year bonds are to be issued with a coupon rate of 7.85%, the higher coupon reflecting the increased risk for the investor.