



**LEADING TREASURY
PROFESSIONALS**

International Treasury Management

Classroom notes

October 2013 diet

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CH. 5 INTEREST RATES (1.2.1)

1 A % of what?

interest rate: cost or return as a percentage of the opening value

nominal or quoted discount rate: cost or return as a percentage of the closing value

(A discount rate' (without the term nominal or quoted) means the interest rate used to discount a value from a future point in time to an earlier date, often today.)

Both are conventionally quoted as a percentage rate per annum

1 basis point = 1bp = 0.01% = 0.0001

1.1 Periodic interest rates (r)

The periodic interest rate, $r = \frac{\text{interest amount received (or paid)}}{\text{divided by the principal}}$

If the period is 1 year (365 days) then this is known as an Effective Annual Rate (EAR)

Example 5.1 Periodic interest

£1m is invested in a 183 day CD and earns interest of £20,054. What is its periodic interest rate?

- (a) 2.00%
- (b) 2.01%
- (c) 4.00%
- (d) 4.04%

2 Years and days.

Nominal or quoted % are always 'per annum'

2.1 How long is a standard year? Two conventions:

- act/360 (or Money Market Yield, MMY): Actual days / 360 day year:
 - used by USD, EUR & many others
- act/365(fixed) (or Bond Equivalent Yield, BEY): Actual days / 365 day year:
 - used by GBP & some others

2.2 Calculating actual days between two dates

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31		31		31		31	31		31		31
	28/29		30		30			30		30	

Leap years: years divisible by 4 have 29 days in February (e.g. 2008, 2012, 2016 etc.)

Example 5.2 Finding actual days

Buy	Sell	Actual days
01/01/11	02/01/11	
01/01/11	31/01/11	
01/01/11	01/02/11	
01/01/11	01/01/12	
01/01/11	31/12/11	
01/01/12	01/03/12	
01/01/11	18/06/11	

3 Dealing and settlement conventions

deal date: date when deal is struck

settlement: date on which money and/or financial instrument changes hands

spot transaction: settlement on the spot date. Most liquid market, so small spreads.

spot date:

- wholly domestic transaction, made before 'cutoff time': same day.
- if either currency non-domestic, or bank account overseas: 2 days
- involves physical delivery or updating of exchange records, e.g. bonds: 2 days
- exception: USD/CAD, MXN/USD FX contracts: 1 day

forward transaction: settlement after spot

'Same day' or 'tom/next': settlement in advance of (2 day) spot.

4 Annualising periodic interest rates

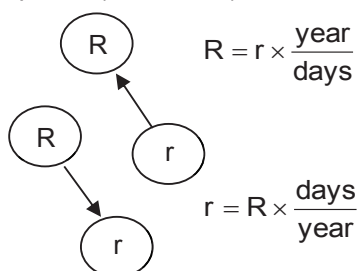
4.1 Nominal (or money, or quoted) rates

- are quoted with an associated period
- are 'annualised' from this associated period on a 'simple' basis
- if they pay a periodic coupon, then this will also be the associated period
- will always include inflation

4.2 Simple and compound interest

Periodic rate \times number of periods in a year = simple annual interest rate.

All quoted (or nominal) interest rates are simple annual rates:



Where: R = nominal or quoted interest rate
 r = periodic interest rate
 days = days in period
 year = days in a standard year (360 or 365)

Markets quote interest rates on an simple annualised basis, from the underlying period
 e.g. 3% 90 day rate

Example 5.3 Calculation of act/360 yield

A money market deposit is made for \$1m on 1st January. On 30th September it will return \$1,030,000. It is not a leap year. What is the instrument's quoted yield?

- 3.000%
- 3.971%
- 4.000%
- 4.026%

Example 5.4 Calculation of act/365 yield

A money market deposit is made for £1m on 1st January. On 30th September it will return £1,030,000. It is not a leap year. What is the instrument's quoted yield?

- 3.000%
- 3.971%
- 4.000%
- 4.026%

4.3 Instruments quoting a yield

How much will you get back at the end of the instruments life?

$$FV = PV \times (1 + r)$$

Where: FV = future value or terminal value

PV = present value or principal invested

r = periodic interest rate

r = R x days/year

Example 5.5 Interest on a debt

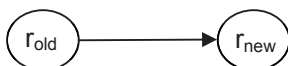
You invest €100,000 on short term deposit for 31 days at a 5% 31 day rate. What is the best estimate of the value of the deposit at redemption?

- (a) €100,415.24
- (b) €100,421.02
- (c) €100,424.66
- (d) €100,430.56
- (e) €105,000.00
- (f) €109,041.67

4.4 Compound interest

To find an 'equivalent' periodic rate over a longer or shorter period requires compounding.

$$r_{\text{new}} = (1 + r_{\text{old}})^{(\text{new}/\text{old})} - 1$$



Where: r_{new} = new period interest rate

r_{old} = old period interest rate

new = period of new interest rate

old = period of old interest rate

(old and new must be in the same units, e.g. days)

Example 5.6 Simple versus compound interest

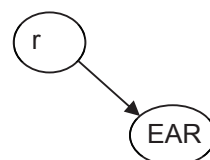
You pay 2% on your credit card each month. What are the annual simple interest rate, and the annual compound interest rate (assume an exact 12 month year)?

	annual simple rate	annual compound rate
(a)	12%	12.68%
(b)	24%	24.34%
(c)	24%	26.82%

4.5 Effective Annual Rates (EAR)

An EAR is a standardised periodic interest rate with interest paid once every 365 day year. A 10% EAR means 10% earned once each year.

Calculating an EAR from a periodic rate, r :



$$EAR = \left(1 + r\right)^{\left(\frac{365}{\text{days}}\right)} - 1$$

Where: EAR = effective annual rate
 r = periodic interest rate
 days = days in period

All instruments have an EAR, regardless of the periodicity of the coupon of the life of the instrument.

Calculating an EAR is one way of comparing interest rates on instruments quoted on different bases - although if such instruments have different terms they might be expected to show different interest rates.

Example 5.7 Calculation of EAR

A money market deposit is made for £1m on 1st January. On 30th September (272 days later) it will return £1,030,000. It is not a leap year. What is the instrument's EAR?

4.6 The link with inflation and real rates

real rate: a rate excluding inflation.

nominal (or money) rate: a rate including inflation

The link between inflation, real and nominal rates is given by the Fisher equation:

$$1 + r = \frac{1 + n}{1 + i}$$

Where: n = nominal or monetary rate
 r = real rate
 i = inflation rate

Example 5.8 Real, nominal and inflation rates

Per period, an instrument yields 12% nominal. Inflation is 5% per period. What is the 'real' rate on this instrument per period?

- (a) 2.40%
- (b) 6.25%
- (c) 6.67%
- (d) 7.00%
- (e) 17.60%

5 Discount instruments

Bills of exchange and banker's acceptances,
GBP & USD Treasury bills,
domestic USD CP

5.1 What is meant by 'discount rate'?

The term 'discount rate' is used in two quite different contexts:

1. A **discount rate** means the interest rate used to find a discount factor, and hence to find the value of a future cash flow in terms of money values on an earlier date.
2. A **nominal (or quoted) discount rate** refers to a Money Market return calculated as a % of the terminal value of the instrument, and always annualised on a simple basis.

The term 'periodic discount rate' can mean either:

1. a discount rate used to find a periodic discount factor, or
2. (interest earned over a stated period) / (redemption value).

[compare this with a periodic interest rate (or yield), which is:
(interest earned over a stated period) / (initial investment)]

This section is concerned with the second meaning.

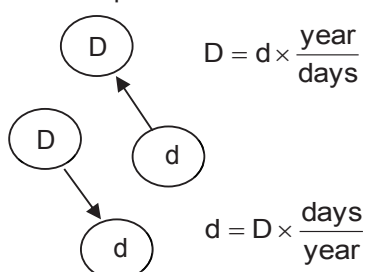
Example 5.9 Periodic discount rate

£1m is invested in a 183 day CD and earns interest of £20,054. What is its periodic discount rate?

- (a) 1.97%
- (b) 2.00%
- (c) 2.01%
- (d) 4.00%

5.2 Annualising the periodic discount rates

Like interest rates, periodic discount rates are annualised to give nominal discount rates, also called quoted discount rates.



Where: D = nominal or quoted discount rate
d = periodic discount rate
days = days in period
year = days in a standard year (360 or 365)

Nominal (quoted) discount rates state an associated period
(e.g. 6% 90 day discount rate).

Example 5.10 Calculation of yields and discount rates

A money market deposit is made for £1m on 1st January. On 30th September it will return £1,030,000. It is not a leap year. What is the instrument's:

- (a) periodic yield
- (b) nominal yield (act/365 (fixed) basis)
- (c) periodic discount rate
- (d) nominal discount rate (act/365 (fixed) basis)

5.3 Converting between discount rates and yields

The relationship between periodic yields and periodic discount rates is:

$$\begin{array}{ccc} \text{(d)} & \longrightarrow & \text{(r)} \end{array} \quad r = \frac{d}{1-d} \quad \begin{array}{l} \text{Where: } r = \text{periodic yield} \\ d = \text{periodic discount rate} \end{array}$$

$$\begin{array}{ccc} \text{(r)} & \longrightarrow & \text{(d)} \end{array} \quad d = \frac{r}{1+r}$$

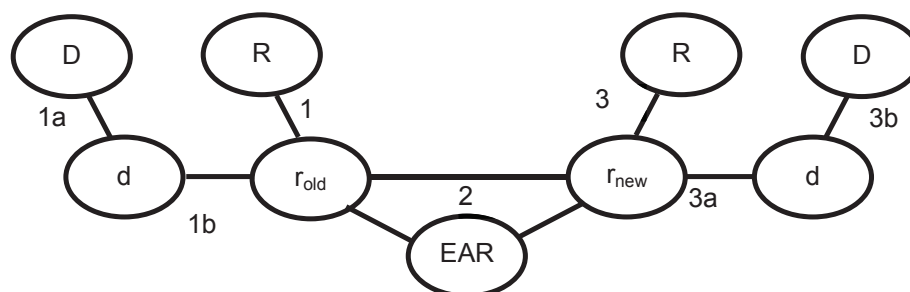
Example 5.11 Conversion between yields and discount rates

A 50 day \$ Certificate of deposit is issued at a discount to the terminal value of 6%. What is the equivalent periodic discount rate, periodic yield and nominal \$ yield?

	periodic discount rate	periodic yield	nominal \$ yield
(a)	0.8219%	0.8152%	5.9511%
(b)	0.8219%	0.8287%	6.0497%
(c)	0.8333%	0.8264%	5.5904%
(d)	0.8333%	0.8403%	6.0504%

6 Converting between rates

6.1 The conversion process



Formulae:

1) R to r:
$$r = R \times \frac{\text{days}}{\text{year}}$$

1a) D to d:
$$d = D \times \frac{\text{days}}{\text{year}}$$

1b) d to r⁸:
$$r = \frac{d}{1 - d}$$

2) compounding:
$$r_{\text{new}} = (1 + r_{\text{old}})^{\left(\frac{\text{new period}}{\text{old period}}\right)} - 1$$

3) r to R:
$$R = r \times \frac{\text{year}}{\text{days}}$$

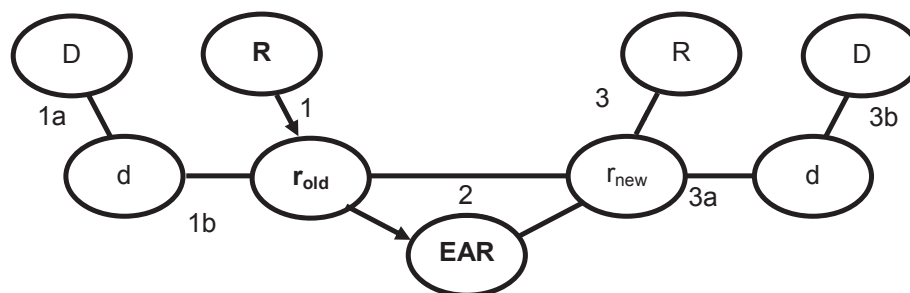
3a) r to d:⁹
$$d = \frac{r}{1 + r}$$

3b) d to D:
$$D = d \times \frac{\text{year}}{\text{days}}$$

⁸ In your calculator, calculate d as a decimal and use $\text{ANS} / (1 - \text{ANS}) =$

⁹ In your calculator, calculate r as a decimal and use $\text{ANS} / (1 + \text{ANS}) =$

6.2 Nominal interest rate to EAR



Example 5.12 Nominal to EAR

Convert the return on each of the following to an EAR:

(a) 10% annual coupon GBP bond (remember, an annual coupon implies an annual yield)

(b) 10% semi-annual GBP bond (remember, a semi-annual coupon implies a semi-annual yield)

(c) 10% quarterly CD

(d) 10% daily GBP bank account, interest added to account daily.

(e) A 10% nominal rate for a 35 day dollar CD.