MODERN FINANCIAL MARKETS AND INSTITUTIONS

A Practical Perspective

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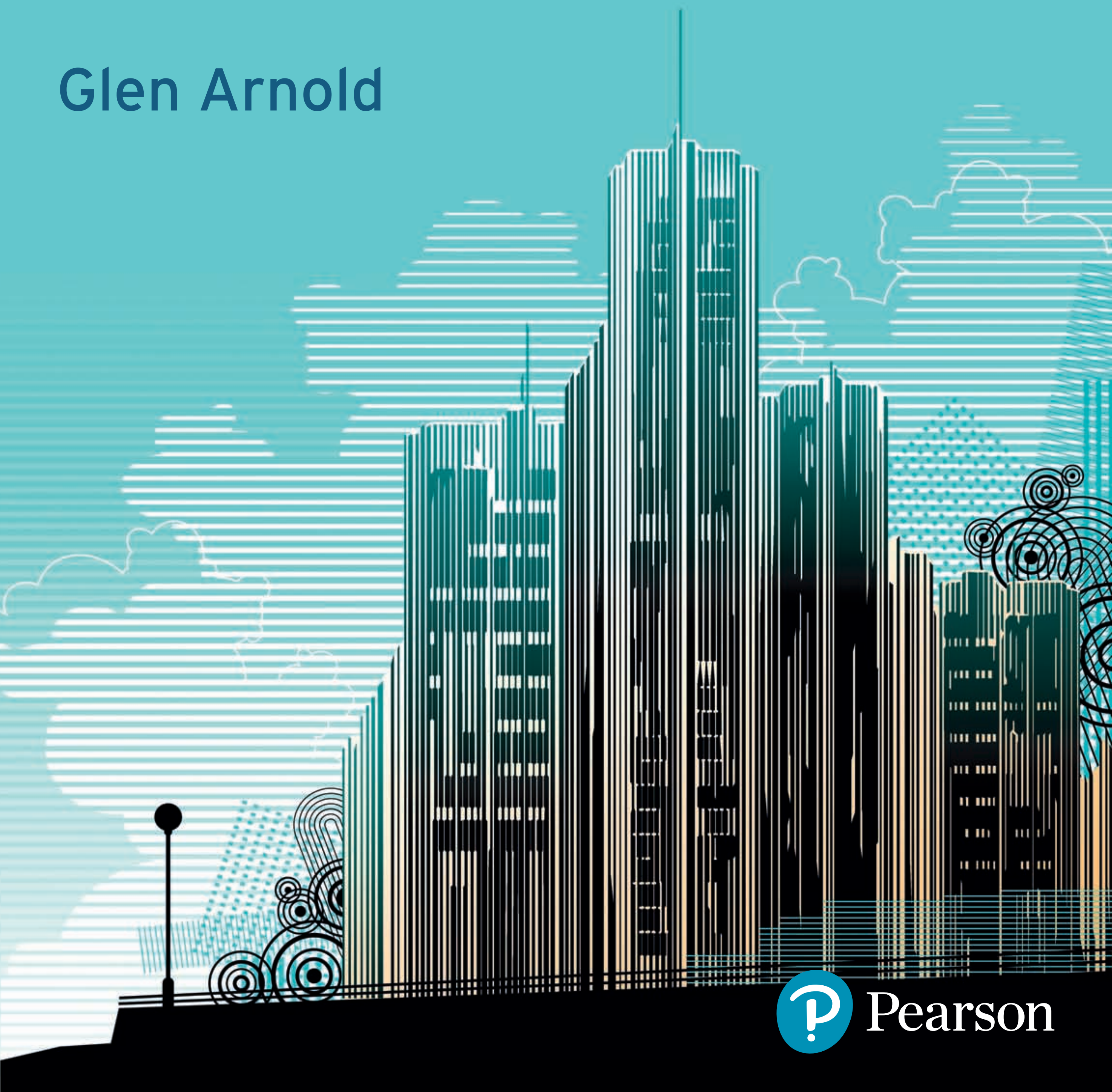

Pearson

MODERN FINANCIAL MARKETS AND INSTITUTIONS

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- Multiple choice questions to help test your understanding
- Links to relevant sites on the World Wide Web
- An online glossary to explain key terms
- Flashcards to help you prepare for exams

F, future income, is double P, the present income.

$$i = \sqrt[25]{\frac{2}{1}} - 1 = 0.0281 \text{ or } 2.81\%$$

The result is not too bad compared with the previous 20 years. However, performance in the 1950s and 1960s was better and countries in the Far East have annual rates of growth of between 5 per cent and 10 per cent.

The investment period

Rearranging the standard equation so that we can find n (the number of years of the investment), we create the following equation:

$$F = P(1+i)^n$$

$$F / P = (1+i)^n$$

$$\log(F / P) = \log(1+i)n$$

$$n = \frac{\log(F / P)}{\log(1+i)}$$

Example 5

How many years does it take for £10 to grow to £17.62 when the interest rate is 12 per cent?

$$n = \frac{\log(17.62 / 10)}{\log(1+0.12)}$$ Therefore $n = 5$ years

An application outside finance: how many years will it take for China to double its real national income if growth rates continue at 10 per cent per annum?

Answer:

$$n = \frac{\log(2 / 1)}{\log(1+0.1)}$$ = 7.3 years (quadrupling in less than 15 years. At this rate it won't be long before China overtakes the US as the world's biggest economy)

Annuities

Quite often there is not just one payment at the end of a certain number of years, there can be a series of identical payments made over a period of years. For instance:

- bonds usually pay a regular rate of interest;
- individuals can buy, from savings plan companies, the right to receive a number of identical payments over a number of years;
- a business might invest in a project which, it is estimated, will give regular cash inflows over a period of years;
- a typical house mortgage is an annuity.

An annuity is a series of payments or receipts of equal amounts. We are able to calculate the present value of this set of payments.

Example 6

For a regular payment of £10 per year for five years, when the interest rate is 12 per cent, we can calculate the present value of the annuity by three methods.

Method 1

$$P_{an} = \frac{A}{(1+i)} + \frac{A}{(1+i)^2} + \frac{A}{(1+i)^3} + \frac{A}{(1+i)^4} + \frac{A}{(1+i)^5}$$

where A = the periodic receipt.

$$P_{10,5} = \frac{10}{(1.12)} + \frac{10}{(1.12)^2} + \frac{10}{(1.12)^3} + \frac{10}{(1.12)^4} + \frac{10}{(1.12)^5} = £36.05$$

Method 2

Using the derived formula:

$$P_{an} = \frac{1 - 1/(1+i)^n}{i} \times A$$

$$P_{10,5} = \frac{1 - 1/(1+0.12)^5}{0.12} \times 10 = £36.05$$

Method 3

Use the 'present value of an annuity' table. (*See* **Exhibit 5.19**, an extract from the more complete annuity table at the end of the book in Appendix III.) Here we simply look along the year 5 row and 12 per cent column to find the figure of 3.605. This refers to the present value of five annual receipts of £1. So to arrive at £3.605 (or £3.6048 to be even more accurate) someone calculated the present value of £1 received in one year, the present value of £1 received at the end of two years, and so on up to five years. Then these five present values are added together.

For our example we are not anticipating £1 for each future year but £10. Therefore we multiply the annuity factor by £10:

3.605 × £10 = £36.05

Exhibit 5.19 The present value of an annuity of £1 per annum

	Interest rate (per cent per annum)				
Year	**1**	**5**	**10**	**12**	**15**
1	0.9901	0.9524	0.9091	0.8929	0.8696
2	1.9704	1.8594	1.7355	1.6901	1.6257
3	2.9410	2.7232	2.4869	2.4018	2.2832
4	3.9020	3.5459	3.1699	3.0373	2.8550
5	4.8535	4.3295	3.7908	3.6048	3.3522

The student is strongly advised against using Method 1. This was presented for conceptual understanding only. For any but the simplest cases, this method can be very time consuming.

Perpetuities

Some contracts run indefinitely and there is no end to a series of identical payments. Perpetuities are rare in the private sector, but certain government securities do not have an end date; that is, the amount paid or the par value when the bond was purchased by the lender will never be repaid, only interest payments are made. For example, the UK government has issued consolidated stocks or war loans which will never be redeemed. Also, in a number of financial valuations it is useful to assume that regular annual payments go on for ever. Perpetuities are annuities which continue indefinitely. The value of a perpetuity is simply the annual amount received divided by the interest rate when the latter is expressed as a decimal.

$$P = \frac{A}{i}$$

If £10 is to be received as an indefinite annual payment then the present value, at a discount rate of 12 per cent, is:

$$P = \frac{10}{0.12} = £83.33$$

It is very important to note that in order to use this formula we are assuming that the first payment arises 365 days after the time at which we are standing (the present time or time zero).

Discounting semi-annually, monthly and daily

Sometimes financial transactions take place on the basis that interest will be calculated more frequently than once a year. For instance, if a bank account paid 12 per cent nominal return per year but credited 6 per cent after half a year, in the second half of the year interest could be earned on the interest credited after the first six months. This will mean that the true annual rate of interest will be greater than 12 per cent.

The greater the frequency with which interest is earned, the higher the future value of the deposit.

Example 7

If you put £10 in a bank account earning 12 per cent per annum then your return after one year is:

$$10(1+0.12) = £11.20$$

If the interest is compounded semi-annually (at a nominal annual rate of 12 per cent):

$$10(1+[0.12/2])(1+[0.12/2]) = 10(1+[0.12/2])^2 = £11.236$$

In Example 7 the difference between annual compounding and semi-annual compounding is an extra 3.6p. After six months the bank credits the account with 60p in interest so that in the following six months the investor earns 6 per cent on the £10.60.

If the interest is compounded quarterly:

$$10(1+[0.12/4])^4 = £11.255$$

Daily compounding:

$$10(1+[0.12/365])^{365} = £11.2747$$

Example 8

If £10 is deposited in a bank account that compounds interest quarterly and the nominal return per year is 12 per cent, how much will be in the account after eight years?

$$10(1+[0.12/4])^{4\times 8} = £25.75$$

Continuous compounding

If the compounding frequency is taken to the limit we say that there is continuous compounding. When the number of compounding periods approaches infinity, the future value is found by $F = Pe^{in}$ where e is the value of the exponential function. This is set as 2.71828 (to five decimal places, as shown on a scientific calculator).

So, the future value of £10 deposited in a bank paying 12 per cent nominal compounded continuously after eight years is:

$$10\times 2.71828^{0.12\times 8} = £26.12$$

Converting monthly and daily rates to annual rates

Sometimes you are presented with a monthly or daily rate of interest and wish to know what that is equivalent to in terms of annual percentage rate (APR) (or Effective Annual Rate (EAR)).

If m is the monthly interest or discount rate, then over 12 months:

$$(1 + m)^{12} = 1 + i$$

where i is the annual compound rate.

$$i = (1 + m)^{12} -1$$

Thus, if a credit card company charges 1.5 per cent per month, the APR is:

$$i = (1 + 0.015)^{12} -1 = 19.56\%$$

If you want to find the monthly rate when you are given the APR:

$$m = (1+i)^{1/12} - 1 \; or \; m = \sqrt[12]{(1+i)} - 1$$

$$m = (1+0.1956)^{1/12} - 1\times 100 \; or \; m = \sqrt[12]{(1+0.1956)} - 1 = 1.5\%$$

Daily rate:

$$(1+d)^{365} = 1+i$$

where d is the daily discount rate.

The following exercises will consolidate the knowledge gained by reading through this appendix (answers are provided at the end of the book in Appendix V).

Mathematical tools exercise

The answers are available in Appendix V.

1 What will a £100 investment be worth in three years' time if the rate of interest is 8 per cent, using: (a) simple interest? (b) annual compound interest?

2 You plan to invest £10,000 in the shares of a company.
   (a) If the value of the shares increases by 5 per cent a year, what will be the value of the shares in 20 years?
   (b) If the value of the shares increases by 15 per cent a year, what will be the value of the shares in 20 years?

3 How long will it take you to double your money if you invest it at: (a) 5 per cent? (b) 15 per cent?

4 As a winner of a lottery you can choose one of the following prizes:
   1 £1 million now.
   2 £1.7 million at the end of five years.
   3 £135,000 a year for ever, starting in one year.
   4 £200,000 for each of the next ten years, starting in one year.

   If the time value of money is 9 per cent, which is the most valuable prize?

5 A bank lends a customer £5,000. At the end of ten years he repays this amount plus interest. The amount he repays is £8,950. What is the rate of interest charged by the bank?

6 The Morbid Memorial Garden company will maintain a garden plot around your grave for a payment of £50 now, followed by annual payments, in perpetuity, of £50. How much would you have to put into an account which was to make these payments if the account guaranteed an interest rate of 8 per cent?

7 If the flat (nominal annual) rate of interest is 14 per cent and compounding takes place monthly, what is the effective annual rate of interest (the APR)?

8 What is the present value of £100 to be received in ten years' time when the interest rate (nominal annual) is 12 per cent and (a) annual discounting is used? (b) semi-annual discounting is used?

9 What sum must be invested now to provide an amount of £18,000 at the end of 15 years if interest is to accumulate at 8 per cent for the first ten years and 12 per cent thereafter?

10 How much must be invested now to provide an amount of £10,000 in six years' time assuming interest is compounded quarterly at a nominal annual rate of 8 per cent? What is the effective annual rate?

11 Supersalesman offers you an annuity of £800 per annum for ten years. The price he asks is £4,800. Assuming you could earn 11 per cent on alternative investments, would you buy the annuity?

12 Punter buys a car on hire purchase paying five annual instalments of £1,500, the first being an immediate cash deposit. Assuming an interest rate of 8 per cent is being charged by the hire-purchase company, how much is the current cash price of the car?

References and further reading

To keep up to date and reinforce knowledge gained by reading this chapter I can recommend the following publications: *Financial Times, The Economist, Bank of England Quarterly Bulletin, Bank for International Settlements Quarterly Review* (www.bis.org), and *The Treasurer* (a monthly journal).

Howells, P. and Bains, K. (2008) *The Economics of Money, Banking and Finance: A European text*, 4th edn. Harlow: FT Prentice Hall.
Provides more detail on the European money markets and puts the markets in the context of economic policy.

Saunders, A. and Cornett, M. M. (2007) *Financial Markets and Institutions*, 3rd edn. New York: McGraw-Hill.
Provides more detail on the US market.

Websites

Bank of England www.bankofengland.co.uk
British Bankers Association www.bba.org.uk
British Bankers Association LIBOR website www.bbalibor.com
Federal Reserve in USA www.federalreserve.gov
Financial Times money market pages www.ft.com/bonds&rates
Fitch www.fitchratings.com
Institutional Money Market Funds Association www.immfa.org
International Monetary Fund www.imf.org
Moody's www.moodys.com
Standard & Poor's www.standardandpoors.com
US Treasury www.treasurydirect.gov
Wholesale Market Brokers' Association www.wmba.org.uk

Video presentations

Bank and financial organisation chief executives and other senior people describe and discuss policy and other aspects of their operations in interviews, documentaries and webcasts at Cantos.com. (www.cantos.com) – these are free to view.

Case study recommendations

See www.pearsoned.co.uk/arnold for case study synopses.
Also see Harvard University: http://hbsp.harvard.edu/product/cases

- BlackRock Money Market Management in September 2008 (A) (2010) Authors: Kenneth A. Froot and David Lane. Harvard Business School.
- Note: Credit Rating Agencies (2009) Author: William E. Fruhan, Jr. Harvard Business School.
- The weekend That Changed Wall Street (2009) Authors: Christopher Brandriff and George (Yiorgos) Allayannis. Darden, University of Pennsylvania. Available from Harvard Case Study website.

Self-review questions

1 What are the functions of money?

2 What are the key characteristics of money markets instruments?

3 What are the main money market instruments?

4 What are Treasury bills, and how is a rate of return from them derived?

5 What is the difference between interest paying and zero coupon instruments?

6 What is the difference between rate of interest, discount and yield?

7 Why is the bond equivalent rate important?

8 Why do (a) governments, and (b) companies, use the money markets?

9 How does the UK government sell its Treasury bills?