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# An Introduction to the bond markets

PATRICK J. BROWN



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**Patrick J. Brown**



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## Preface

In contrast to the equity markets, why is it that to the average private investor or non-bond market professional that bonds and the bond markets around the world are a closed book? This is surprising when you consider that:

- Bonds are intrinsically safer investments than equities.
- Bonds are usually easier to value than equities. After all, they often have predefined returns.
- The size of the bond markets and the trading of derivatives based on bonds between financial institutions is many, many times larger than that of the equity markets. Worldwide the size of the bond markets is measured in trillions of US dollars (\$1 trillion = \$1 000 000 000 000). For example, the repo markets (essentially a form of short-term secured borrowing using bonds as collateral) in Europe have a daily turnover in excess \$1 trillion; the interest rate and currency swap markets have outstanding transactions with a nominal value in excess of \$180 trillion, etc.

However, possibly the question has been put the wrong way round. We should possibly be asking, why are the equity markets so attractive? Many people like to have a gamble, and they regard the equity markets as an attractive place to do this. People like to think that they are able to assess the prospects of a company, presumably better than the market, and in the process make a fortune. Holding bonds, on the other hand, with their predefined returns, does not offer this possibility. After all, how many people are prepared to put £1 into a sweepstake, which has a 1 in 1000 possibility of producing a payout of £1000, compared with the number who are prepared to accept £1 if there is a 1 in 1000 chance that they are prepared to pay out £1000. The odds for both strategies are identical.

This lack of sex appeal of bonds is only part of the problem, and even this can be removed with the use of futures, swaps and other derivatives, although these are often not directly available to the private investor. However, this approach, with its highly mathematical basis, makes the bond markets even more remote and unattractive to many people.

Another significant reason for the lack of interest in the bond markets, in spite of their size, is their lack of transparency. With the equity markets many, if not most, national newspapers publish daily closing prices of leading equity shares. It is true that they also publish closing prices for domestic government bonds, but the great majority of outstanding bonds are not issued by governments. Even the *Financial Times* produces daily prices for well under 100 bonds, out of the many thousands of outstanding public bonds in Europe. The bond price discovery process is much more complicated than for equities, for although many eurobonds

are quoted on the Luxembourg or London stock exchanges, nearly all the trading is done off-exchange.

Lack of transparency in the bond market does not stop with price discovery. With equity shares, companies have to produce annual accounts and periodic updates which are made available to all shareholders and which can be easily obtained by other interested parties. These help in evaluating the worth of the shares. On the other hand, with bonds, at least in Europe, the annual accounts do not normally identify the breakdown of the outstanding debt. Similarly, it is often quite difficult, at least for an individual, to find the individual terms and guarantees associated with the debt instruments.

The purpose of the book is to give an introduction to the bond markets to readers who have an interest in understanding what they are, how they work and how they can be used, but who do not want to be intimidated by mathematical formulae. As a result it is hoped that readers will be able to evaluate the appropriateness of investing in the bond markets. This is achieved by frequently illustrating the points graphically, relegating most of the mathematical formulae to Appendix A and supplementing the book with a companion website.

The book stands up in its own right without using the website. However, in order to take full advantage of it, users will need a PC with Excel. The website enables readers to:

- enter bond details and calculate expected returns;
- calculate annuity payments;
- produce a variety of yield curves and from them project expected interest rates in the future;
- calculate returns for the reader’s own bond market portfolio of investments, based on a variety of scenarios about future interest rates and the user’s investment time horizon; etc.

Another objective of this book is to try to demystify at least some of the bond market terminology, so that it is possible for non-bond market professionals to understand how the instruments work and to appreciate the expected gains. To illustrate this let us consider two examples.

If you are offered two, otherwise identical investments, one that pays 4 % every six months (that is 8 % per year) and the other that pays 8.16 % once a year, which one should you choose, or does it not matter? This is the sort of problem that has occurred in the past in the UK, and no doubt other countries, with savings rates offered by building societies and other financial institutions. This problem has, at least partly, been solved by a requirement to publish the Annual Equivalent Interest Rate.

Another example comes from a recent advert for a UK high income ISA,<sup>1</sup> which proudly promotes tax-free income and:

<b>6.57</b>	<b>%</b>
	<b>p.a.</b>
Current gross running yield.	
<b>5.79</b>	<b>%</b>
	<b>p.a.</b>
Current gross redemption yield.	
Yields are as at 31.05.05 and will vary.	

<sup>1</sup> ISA stands for ‘Individual Savings Account’. Such accounts, which are subject to a number of restrictions, allow UK citizens to receive interest from and realize capital gains on these accounts tax-free.

In the small print it also says: 'In order to generate a high level of income, the Trust invests in companies that offer bonds with a significant level of risk to capital.'

How many people not trading in the market actually understand what these two figures mean, and would allow for the possibility of some of the investments either defaulting or having to be sold at a loss prior to any default? I know that many of the people that I know do not.

To give the providers of the ISA their due, it does say further on in the small print that: 'It [the redemption yield] will be lower than the current running yield if the capital value of the trust is expected to decrease. Both yields will vary.' So unsurprisingly, they are expecting the capital value of the ISA to decrease!

It is very difficult, if not impossible, to predict the future return on ordinary shares. However, with fixed interest investments, subject of course to the issuer not getting into serious trouble, the future cash flows arising from the investment are usually specified, although the issuer may sometimes be able to exercise an option that changes the cash flows. Similarly, with floating rate instruments, the future returns are usually specified relative to some external measure, such as LIBOR (London Interbank Offer Rate) or EURIBOR (Euro Interbank Offer Rate).

You would think that the defined terms would be an advantage and would encourage investment in bonds. However, this means that you cannot buy a bond investment that will give you almost unlimited gains as one always hopes one can with an equity share. On the other hand, although not for the novice, it is possible to obtain similar gains, or losses, to those on equities, using bond derivatives.

Bonds are essentially intrinsically safer investments than equities. There is no reason why people should not understand how bonds work and be happy to invest in them. After all, anyone buying a house on a mortgage is in effect just issuing a bond to the company from whom they are borrowing the money.

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# Introduction

Trading in bonds or loans is not a recent invention. Although stock exchanges date from the early 15th century,<sup>1</sup> by the beginning of the 17th century trading and speculation in government stocks and shares in the Dutch East India Company on the Amsterdam stock market was carried out in a modern way. Although Amsterdam is often referred to as the 'first stock market', state loan stocks had been negotiable much earlier in Venice, in Genoa and before 1328 in Florence. There are references to French '*Rentes sur l'Hôtel de Ville*' (municipal stocks) in 1522 and stock markets in the Hanseatic towns from the 15th century.

It appears that the *Rentes sur l'Hôtel de Ville* did not play the same role as annuities did in England, but remained a safe gilt-edged investment, which was often immobilized in an inheritance, difficult to negotiate and subject to tax on sale. Based on a French text<sup>2</sup> written in 1706, it compares the French situation to that pertaining in Italy, Holland or England where 'State bonds (are bought and transferred) like all buildings, with no cost or formality.' Moreover, the English annuities could also be regarded as an alternative currency, sufficiently guaranteed, carrying interest and immediately convertible into liquid cash at the Exchange. However, what was new to Amsterdam was the volume, the liquidity of the market, the publicity and the freedom to speculate.

The purpose of this book is to give a basic introduction to the workings of the securities markets and the bond market in particular. It will look at the different types of instruments, explain how they differ and are traded. It will try, at least partially, to answer questions such as:

- What is a bond?
- Who issues bonds?
- Why do people issue bonds and why do investors buy them?
- How does it differ from an equity or ordinary share?
- How safe is my investment in a bond?
- How much money will I get back?
- When will I get the money back?
- Why does a bond yield more/less than an equity?
- How do you value a bond?
- How can you make use of bonds?

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<sup>1</sup> Bruges dates from 1409, Antwerp 1460, Lyons 1462, Toulouse 1469, Amsterdam 1530, London 1554: see Fernand Braudel (1982).

<sup>2</sup> See Fernand Braudel (1982).



This book is intended to be an introduction to the bond markets and as a result the formulae for how to calculate redemption yields, duration, convexity, discounted margins or other calculations are delegated whenever possible into Appendix B.<sup>3</sup> Similarly, it does not go into the details of the various traded futures and derivative contracts. Neither does it go into all the possible variations and options on the different instruments. The major security houses and hedge funds employ ‘rocket scientists’ to construct new variations every week, sometimes with disastrous effects. (Even today, what happened to Long Term Capital Management sends shivers around the world’s capital markets.)

After the Introduction, the first chapter in the book describes what a bond is and who issues them. This is followed by a chapter that describes the main standard types of bonds, including fixed-rate, floating-rate and index-linked bonds, together with some of the tradeable money market instruments, which behave in a similar way to short-dated bonds. The description of bonds with a variety of embedded options, such as call and put options, has been relegated to Chapter 4. Chapter 3 describes how bonds are priced and valued. It introduces the concepts of accrued interest, current and redemption yields, Macaulay and modified durations, convexity and dispersion, together with why they are calculated. For floating-rate notes, it also describes the simple and discounted margin calculations, and real redemption yields for index-linked bonds. The results of the calculations are often illustrated graphically with the formulae relegated to Appendix B. The next chapter, Chapter 4, describes bonds with a variety of options, together with the effect that the options can have on the valuation of the instrument.

Chapter 5 on yield curves describes the different types of yield curves, including spot, par and forward curves, and how they can be calculated. It also discusses how yield curves can be used to develop strategies that may increase the return on a bond portfolio. A discussion of the repo market follows in the next chapter. Repos are essentially just a form of short-term secured borrowing which are used extensively and help in making the financial markets run smoothly. It also discusses the differences between classic repos, sell and buy-back agreements and stock lending.

Chapter 7 looks at the profits and losses that can be achieved by buying and writing options, together with a flavour of how they can be used. Non-structural instrument risks are discussed in the next chapter. This includes credit risk and bond ratings, together with the liquidity risk that can occur if it is necessary to realize a holding in a non-benchmark bond before its maturity.

Chapter 9 describes swaps, futures and other derivatives. It looks at the size and variety of standard interest rate swaps together with a number of variations, including asset swaps, cross-currency swaps, basis swaps and forward rate agreements. It goes on to discuss futures and credit default swaps.

Chapter 10 discusses a variety of topics including holding period returns, immunization, the calculation of portfolio durations and yields and allowing for tax on interest payments and capital profits. This is followed by a chapter on bond indices. It discusses the appropriateness of using one index against another when comparing the performance of a portfolio.

Appendix A describes the programs that have been supplied on the companion website. Some of the programs allow users to create their own bonds and simulate the effect of various changes in rates or prices. Others allow you to create and modify yield curves, and see their effect on bond values. Appendix B gives the mathematical formulae for most of the calculations described and used in the preceding chapters, while Appendix C is a bond market glossary.

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<sup>3</sup> Many of these formulae can be found in Patrick Brown (1998).

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# What Is a Bond And Who Issues Them?

Over many years whenever I mentioned the bond market socially, people would often enquire ‘What is a bond?’, as if bonds were something from outer space. This would never happen if one were to mention the equity or share markets. On explaining that if bank loans or mortgages were tradeable they could be regarded as types of bonds and that many governments raise money by issuing bonds, many people immediately lost interest. This need not be the case; bonds can be sexy! However, unlike equities, except in the case of a few structured deals, the possibility, however remote, of a nearly infinite return is impossible.

In general terms, a bond is a loan by one party (the investor or holder) to another party (the issuer). The issuer gives the investor a guarantee that he or she will pay interest on the loan at regular intervals and repay the loan at a specified time in the future. In addition, the issuer may retain or grant embedded options that he or she or the investor can exercise in the future.

The terms ‘bonds’<sup>1</sup> and ‘loans’ have been used almost interchangeably throughout the book. The description ‘note’ is also used extensively, but it frequently refers to a bond that was originally issued for a period of not more than five years or to a floating-rate note. In addition, bonds have sometimes been referred to as ‘stocks’, which is a term that has been used by the Bank of England over many years to refer to UK Government gilt-edged issues. Its use should not be confused with ‘common stocks’, which are equity issues. The description of a bond is often very easy to understand as in the following example.

## **Example 1.1    Bundesrepublik Deutschland 3 $\frac{3}{4}$ % Anleihe 2009**

In January 1999, Germany issued €14 billion of this bond at a price of 100.34. It will pay interest every 4 January up to and including 4 January 2009, when it will be redeemed at 100. It can be traded in multiples of €0.01 and is in a fully registered form. It is listed on all the German stock exchanges, and is thus tradeable.

In the above example, the issuer, in this case the German Republic, normally guarantees the issue, but the guarantees can vary from issuer to issuer and bond to bond. ‘Registered’ just means that the owner of the bonds is held on a central register.

Bonds are usually referred to by a combination of the issuer name, annual coupon rate per cent and the maturity date or dates. However, the description of the bond, especially in Continental Europe, may also include the year of issue or the series number. The description does not normally specify the frequency of the coupon payments.

<sup>1</sup> Sometimes the description ‘bond’ refers to an investment that includes some sort of insurance guarantee and implicit premium. Such investments are not discussed here.



## **1.1 DESCRIPTION OF A BOND**

A bond can generally be described in terms of its:

- issuer;
- size and currency;
- type;
- coupon payments and frequency;
- redemption amount and maturity dates;
- embedded options, such as whether and under what circumstances the bond can be redeemed early;
- guarantees relating to the payment of interest and return of capital; and
- where quoted and traded.

### **1.1.1 The issuer**

From the market's point of view, there are very few restrictions as to who can issue bonds, provided they provide acceptable payment guarantees. However, financial service regulators often have different views and impose a variety of capital adequacy restrictions.

The 'issuer' of a bond may be a country, regional government, local authority, bank, company, supranational organization or even an investment vehicle that has been created specifically for the issue of this bond. The name of the bond issue is sometimes followed by either its issue number (as is the case with Japanese Government bonds) or its year of issue.

### **1.1.2 Size and currency**

The size of a loan is often referred to as its 'principal' or 'nominal amount'. Interest and capital repayments are based on the nominal amount and not the amount of money that is raised. Bonds are frequently issued at a price that is a small discount to their nominal or 'par' value. The issuer often agrees to pay back the nominal value of the bond at redemption, although sometimes he has to pay a premium if he wants to repay it early.

The bond will also specify the currency of issue. Occasionally, usually in the past, an artificial currency unit, such as Special Drawing Rights or the European Currency Unit, has been specified. In another variant, investors have even had the right to choose the currency in which they would like the interest paid and the capital repaid.

### **1.1.3 Type**

Nearly all bonds can be categorized into one of three different types according to how their interest and capital repayments are calculated. These are 'fixed-rate', 'floating-rate' and 'index-linked' bonds. The majority of fixed-rate and floating-rate bonds are redeemed at par, whereas with index-linked bonds the final redemption amount is also adjusted.

### **1.1.4 Coupon payments and frequency**

The bond terms will specify the frequency and the amount of any coupon payments. The coupon rate is usually specified as an annual percentage rate, irrespective of the coupon payment

frequency. The payment frequency will usually be annually, semi-annually, quarterly, monthly or only at maturity. Most fixed-rate bonds pay coupons either annually or semi-annually, whereas floating-rate notes often pay coupons quarterly or monthly.

The coupon payments may be specified as either an actual fixed amount (fixed-rate bonds), variable according to some external measure such as an interbank interest rate (floating-rate note) or index-linked to, e.g. in the case of UK index-linked issues, the UK Retail Price Index (RPI).

If a fixed-rate bond pays a coupon twice a year, except sometimes at the beginning and end of its life, the semi-annual coupon payment will be exactly half the annual rate. This is not so with floating-rate notes, where the individual payments are dependent on the exact number of days in the period and the payment dates are adjusted to make sure that they fall on a market business day.

It is quite usual for bonds to have a long or a short first coupon payment period.

### Example 1.2

An issuer may find that the conditions are currently attractive for the issue of, say, a 10 year bond. However, because, for example, of when his or her income is received, or because it would be desirable to make the coupon payments coincide with those of some other bond issues, a long or a short first interest period is required.

The bond is to be issued into a market where coupons are normally paid twice a year. The issuer wishes to pay coupons in March and September each year. If the market conditions in, say, January or February are attractive for the issue, then the first coupon payment will probably be in the September, not the March immediately after the issue date. The coupon payment will then be increased to compensate the investor for the longer payment period.

Conversely, if the market conditions are not attractive for the issuance until April, the first coupon payment will frequently occur in September after issue, but the amount will now be reduced because of the shorter time period.

### 1.1.5 Redemption amount and maturity dates

The terms of the bond will usually specify when the issuer will repay the bond (the 'maturity date') and how much will be repaid (the 'redemption value'). The bond terms could specify several different dates and values or it could specify at any time between certain dates. These are discussed further below. Except in the case of an annuity, a zero-coupon bond being called early or a capital restructuring, the redemption amount is rarely less than the nominal value of the bond. For most fixed-rate and floating-rate bonds, unless they are called early, the redemption price is 'par', i.e. equal to the nominal value. For index-linked bonds the redemption value will rise, or in rare cases even fall, in line with the relevant index.

The terms will normally highlight the final maturity date or in the case of a serial bond (which is redeemed in a number of different tranches) a range of dates. There is, however, a number of bonds that do not specify a final maturity date. Instead, such bonds often specify that they may be redeemed by the issuer on or after a specified date, at a certain price, subject to, say, three months' notice. (This is a 'call option' – see below). Such bonds are called 'undated bonds', 'irredeemables' or 'permanent interest-bearing securities'.



### 1.1.6 Embedded options

As has been already indicated, bonds often give the issuer or the holder of the bond the option of a choice at some time in the future. This section highlights some of the more common options.

Sometimes the embedded option is exercised not by the issuer or the holder but as a result of some external event, e.g. if the tax status of the issue changes, making the issue unattractive, or the issuer is taken over by another company. This latter example provides extra security for investors, as it is not unknown for a company to take over another well-funded company and strip out its assets. Bond holders, unfortunately, have no say in the running of a company.

#### **Example 1.3 Ford Motor Company $6\frac{3}{8}\%$ Debentures 2029**

\$1.5 billion of the debentures were issued at 98.817 in February 1999. It pays interest semi-annually on 1 February and 1 August, and it will be redeemed at 100 on 1 February 2029, unless its tax status changes. If this occurs, it may be called as a whole at any time on 30 days' notice from 9 February 1999 at 100.

A 'call option' gives the issuer the right to redeem the issue early after an appropriate notice period. The terms may specify that the call option may only be exercised on or between specified dates. The terms for the call are frequently different to the terms if the bond goes to its normal maturity date. A call option is included in all undated issues, and most asset-backed issues backed by mortgages.

#### **Example 1.4 Aetna Life and Casualty Company $7\frac{3}{4}\%$ Notes 2016**

The company issued \$200 million in July 1986 at 101. It pays interest annually on 17 July and will be redeemed on 17 July 2016 at 100 unless it is called earlier. The bond is callable as a whole or in part at any time on 30 days' notice at the following rates: from 17 July 2001 at 106; 2002 at 105; 2003 at 104; 2004 at 103; 2005 at 102; 2006 at 101 and 2007 at 100. It is also callable if its tax status changes.

A 'put option' gives the bond holder the right to demand early redemption on one or more dates, or between specified dates. The put option may only be exercisable if a certain event occurs.

A 'convertible bond' gives the bond holder the right to convert the bonds into another instrument, e.g. the ordinary shares of the issuer. The conversion option usually occurs at a date prior to the redemption of the bond, with the result that after this date, if the option is not exercised, they revert to being non-convertible bonds.

#### **Example 1.5 Nichiei Company Ltd $1\frac{3}{4}\%$ Convertible Bonds 2014**

In February 1999 the company issued JPY 50 billion of convertible bonds at 100 for redemption on 31 March 2014 unless called or converted beforehand. Interest is payable semi-annually on 31 March and 30 September.