1 Investment Assets Held by Pension Funds

In this chapter we consider the full range of assets in which a pension fund might consider investing. These comprise financial assets (principally money-market securities, bonds and loans, shares and collective investment vehicles), real assets, derivatives and alternative investments. We also examine how these assets are valued or priced.[1] Finally, we review the different characteristics of the different assets and how the assets are used in pension fund portfolios.

1.1 MONEY-MARKET SECURITIES

Money-market securities are short-term instruments with maturities of less than one year. There are two main classes: those that are quoted on a *yield basis* and those that are quoted on a *discount basis*.

The most important examples of money-market securities that are quoted on a yield basis are money-market deposits and negotiable certificates of deposit. Such instruments are always issued at par. *Money-market deposits* are fixed-interest, fixed-term deposits of up to one year with banks. The deposits can be for the following terms: overnight, 1 week, or 1, 2, 3, 4, 5, 6, 9 or 12 months. They are not negotiable, so cannot be liquidated before maturity. The interest rates on the deposits are fixed for the term and are related to LIBID (the London inter-bank bid rate) of the same term. The interest and capital are paid in one lump sum on the maturity day.

Negotiable certificates of deposit (CDs) are receipts from banks for deposits that have been made with them. The deposits themselves carry a fixed interest rate related to LIBID and have a fixed term to maturity, so cannot be withdrawn before maturity. But the certificates or receipts on those deposits can be traded in a secondary market; that is, they are negotiable. CDs are, therefore, very similar to negotiable money-market

[1] Further details of the pricing of the instruments considered below can be found in Blake (2000).

deposits, although the yields are about 0.25% below the equivalent-term deposit rates because of the added benefit of liquidity. The maturities of CDs are generally between one and three months, although some CDs have maturities in excess of one year (e.g. five years). Interest is paid at maturity, except for CDs lasting longer than a year, in which case interest is paid annually. While most CDs are fixed-rate, some have variable interest rates. For example, a 6-month CD could have a 30-day roll-over; this means that the interest rate on the CD is related to 6-month LIBID and is fixed for 30 days, and it will change every 30 days if LIBID has changed. Pension funds hold CDs in sterling and the major overseas currencies.

Another money-market security quoted on a yield basis is a *repurchase agreement* (or repo). This involves lending cash using a government bond as collateral for a specified term; that is, the bond is sold for cash with an agreement to repurchase it at a later date. The transaction from the counterparty's position is known as a *reverse* (or reverse repo).

Treasury bills, local-authority bills, bills of exchange, bankers' acceptances and commercial paper are the most important examples of money-market securities that are quoted on a discount basis; that is, they are sold on the basis of a discount to par.

Treasury bills (*TBs*) are short-term UK Government IOUs of 3 months' duration. On maturity the holder is paid the par value of the bill from the National Loans Fund. *Local-authority bills* are similar to TBs but are issued by local authorities. *Bills of exchange* (or *trade bills* or *commercial bills*) are also similar to TBs but are issued by private companies against the sale of goods. They are used to finance trade in the short term.

Bankers' acceptances are written promises issued by borrowers to banks to repay borrowed funds. The lending bank lends funds and in return accepts the bankers' acceptance. The acceptance is negotiable and can be sold in a secondary market. The investor who buys the acceptance can collect the loan on the day that repayment is due. If the borrower should default, the investor has legal recourse to the bank that made the first acceptance.

Commercial paper (CP) comprises unsecured promissory notes issued by large corporations. The notes are not backed by any collateral, rather, they rely on the high credit rating of the issuing corporation. Such corporations also tend to maintain credit lines with their banks sufficient to repay all their outstanding commercial paper. CP is therefore a quickly and easily arranged alternative to a bank loan. The sterling commercial-paper market began in 1986. *Medium-term notes* (MTNs) are unsecured

notes with durations of between 9 months and 40 years whose issuance is underwritten by an investment bank.

All these securities are sold at a discount to their par value. On maturity the investor receives the par value. Explicit interest is not paid on discount instruments. However, interest is reflected implicitly in the difference between the discounted issue price and the par value received at maturity.

Money-market funds are pooled portfolios of money-market instruments offering safety and liquidity combined with yield. The instruments must be at least A1/P1 quality, have a weighted average maturity of no more than 60 days, have no more than 10% invested in the instruments of any one issuer and no more than 20% in repurchase agreements, and have daily dealing and same-day settlement. There must also be a complete separation between fund manager and custodian.

Pension fund trustees are monitoring the returns from cash more intently than in the past: it is no longer acceptable for administrators and fund managers to simply leave surplus cash, arising from contributions and dividends etc., in a bank account with the custodian.

We will illustrate the valuation or pricing of money-market instruments, using TBs as an example. TBs are quoted on the basis of a *discount rate*. The issue price of TBs is determined as the difference between the face value and the *discount*. Given the discount rate, d, the discount is found as follows:

$$\text{Discount} = 100 \times d \times (Nim/365) \tag{1.1}$$

where Nim is the number of days between issue and maturity. From this we can find the issue price as:

$$\begin{aligned} P^{\text{TB}} &= 100 - \text{Discount} \\ &= 100 \times \left[1 - d\left(\frac{Nim}{365}\right)\right] \end{aligned} \tag{1.2}$$

If we know that the discount rate on a 91-day £100 TB is 10%, then we can calculate the issue price as:

$$\begin{aligned} P^{\text{TB}} &= 100 \times \left[1 - 0.10\left(\frac{91}{365}\right)\right] \\ &= 97.51 \end{aligned}$$

implying a discount of £2.49.

The *equivalent yield*, r, on the TB is given by:

$$\begin{aligned} r &= \frac{\text{Discount}}{P^{\text{TB}}} \times \frac{365}{Nim} \\ &= \frac{d}{1 - d(Nim/365)} \end{aligned} \tag{1.3}$$

For the TB given here:

$$\begin{aligned} r &= \frac{0.10}{1 - 0.10(91/365)} \\ &= 0.1026 \quad (10.26\%) \end{aligned}$$

The alternative way of pricing the TB is to substitute the yield into a standard present value formula[2]:

$$\begin{aligned} P^{\text{TB}} &= \frac{100}{[1 + r\,(Nim/365)]} \\ &= \frac{100}{[1 + 0.1026(91/365)]} \\ &= 97.51. \end{aligned} \tag{1.4}$$

This means that £97.51 is the present value of £100 to be received in 91 days' time when the yield is 10.26%. This is because if we invested £97.51 for 91 days when the annual interest rate is 10.26%, we would end up with exactly £100.

The important point to note is that with all discount securities the yield is always greater than the discount rate; i.e. $r > d$. This follows precisely because the securities trade at a discount: the return of £2.49 is achieved with an investment of only £97.51, not £100; the yield is based on £97.51, whereas the discount is based on £100.

Equation (1.4) is an example of a *discounted cash flow pricing model*: the future cash flows on the security (in this case just the principal repayment on the maturity date of the Treasury bill) are discounted (using an appropriate yield or discount rate) to the current date and then summed to derive the present value of the security. The financial markets use discounted cash flow models to value securities that generate future cash flows.

[2] Present values are explained in Appendix A of the book.

1.2 BONDS AND LOANS

Bonds are capital-market securities and as such have maturities in excess of one year. They are negotiable debt instruments. There are many different types of bonds that can be issued. The most common type is the *straight bond*. This is a bond paying a regular (usually semi-annual), fixed coupon over a fixed period to maturity or redemption, with the return of principal (that is, the par or nominal value of the bond) on the maturity date. All other bonds will be variations on this. The frequency of coupon payments can differ between bonds: for example, some bonds pay coupons quarterly, others pay annual coupons. The coupon-payment terms can differ between bonds: for example, some bonds might not pay coupons at all (such bonds are called *zero-coupon bonds* and they sell at a *deep discount* to their par values, since all the reward from holding the bond comes in the form of capital gain rather than income); some bonds make coupon payments that change over time, for example, because they are linked to current market interest rates (*variable-rate bonds* or *floating-rate notes*), and some bonds make coupon payments only if the income generated by the firm that issued the bond is sufficient (such bonds are known as *income bonds*; unlike other bond-holders, an income-bond holder cannot put the issuing company into liquidation if a coupon payment is not paid). The redemption terms can differ between bonds: some bonds have a range of possible redemption dates (such bonds are known as *double-date bonds*) and sometimes the actual date of redemption is chosen by the issuer (*callable bonds*) and sometimes it is chosen by the holder (*puttable bonds*); some bonds have no redemption date at all, so that interest on them will be paid indefinitely (such bonds are known variously as *irredeemables*, *perpetuals* or *consols*). Some bonds have option features attached to them: callable and puttable bonds are examples of this, as are *convertible bonds* (bonds that can be converted into other types of bonds or into equity) and *bonds with warrants* attached to them.

Bonds can also be differentiated by their issuer. Most bonds in the UK are issued by the British Government in order to finance and manage the national debt; they are commonly known as *gilts*. Then there are bonds that are issued by UK public authorities, especially local authorities. Such bonds are secured on the revenues of the local authorities and are generally not guaranteed by the government. The duration of local-authority bonds is typically between one and five years, although most are for one year and are known as *yearling bonds*.

Private companies also issue bonds, known as *corporate bonds*. There are several classes of corporate bonds. *Debentures* are the most secured form of corporate debt (unlike in the USA, where debentures are unsecured corporate obligations). They are secured by either a *fixed* or a *floating charge* against the assets of the company. *Fixed-charge debentures* specify certain specific assets that are chargeable as security and the company is not permitted to dispose of them; in the event of default, the assets are sold and the proceeds used to repay the debenture-holders. *Floating-charge debentures* are secured by a general charge on all the assets of the company. The company is able to dispose freely of assets until a default crystallises the floating charge, at which time the charge fixes on the assets of the company that are not secured by a fixed charge. Fixed-charge debentures rank above floating-charge debentures in the event of default, but only floating-charge debenture-holders can ask for a company to be declared insolvent under the 1986 Insolvency Act.

Unsecured loan stocks are corporate bonds that are not secured by either a fixed or floating charge. In the event of liquidation, loan-stock holders rank beneath debenture-holders and preferential creditors (such as Her Majesty's Customs and Revenue (HMRC), formerly the Inland Revenue). *Guaranteed loan stocks* are corporate bonds that are not secured by a fixed or a floating charge but are guaranteed by a third party, typically the parent company of the issuer.

Asset-backed bonds are bonds backed by assets which generate predictable cash flows, such as rents and interest on mortgages, loans and credit cards (the process of issuing asset-backed bonds is sometimes known as *securitisation*).

Corporate bonds tend to be less liquid than gilts; partly this is because many bonds are held to maturity and hence not traded. Corporate bond price indices are provided by iBoxx, a consortium of investment banks.

Bonds can also be distinguished by the currency of denomination. Bonds issued in the UK in sterling by domestic issuers or foreign issuers are known as *domestic* and *foreign* (or *bulldog*) *bonds,* respectively. The coupons on domestic bonds are generally paid net of UK basic-rate income tax, whereas the coupons on bulldogs do not generally have tax deducted.

Bonds issued and/or traded in the UK in a currency other than sterling are known as *eurobonds* or *international bonds* (the introduction of the euro as a currency has changed the use of the term eurobond to avoid confusion with euro-denominated bonds). The first eurobond was issued in 1963 by the Italian company Autostrada with a coupon of 5.5% and

an issue size of $15m. *Eurosterling bonds* were first issued in 1972; they have all the characteristics of eurobonds, rather than those of domestic or bulldog bonds, and the main issuers have been UK building societies seeking long-term funds to finance their home loans. The main currencies of issue of eurobonds are US dollars, euros and Japanese yen. They are generally issued by multinational companies, international agencies (such as the World Bank) and sovereign governments, and are generally unsecured. New issues are underwritten and placed with investors by a syndicate of international banks led by a *lead manager bank* (such as UBS, Merrill Lynch or JP Morgan). The size of a eurobond issue usually lies between $50m and $l00m, with a maturity of about six or seven years. Eurobonds are principally in bearer form, transferable by delivery with no record of holder. The bond certificates have detachable coupon claim tokens and coupon payments are generally paid annually free of UK income tax and withholding tax. Eurobonds are usually listed on the London or Luxembourg stock markets.

The international bond market has been the most innovative of all bond markets in designing new types of bond, in terms of both coupon payments and redemption proceeds. For example, there are: *dual-currency bonds*, where the coupon payments are in one currency and the redemption proceeds are in another; *currency-change bonds*, where coupons are first paid in one currency and then in another; *deferred-coupon bonds*, where there is a delay in the payment of the first coupon; *multiple-coupon bonds*, where the coupon payments change over the life of the bond (although in a predetermined manner); *fixed-then-floating bonds*, where the coupons change from being fixed-rate to floating-rate; *floating-then-zero bonds*, where the bonds change from being floating-rate coupon bonds to zero-coupon bonds; and *missing-coupon bonds*, where a coupon payment is missed whenever a dividend payment on the issuing corporation's shares is missed.

With *index-linked* or *indexed bonds*, the coupon and principal are linked to a particular index, such as the retail price index (RPI), a commodity price index (for example, oil) or a stock-market index. Index-linked government bonds were first introduced in the UK in March 1981. These bonds are linked to the RPI and are therefore designed to give a constant *real* yield. Initially, only pension funds could invest in them, because pension funds had (partially) index-linked pensions to deliver to their pensioners. However, since March 1982, any investor can hold index-linked gilts. Most of the index-linked stocks that have been issued have annual coupon payments of 2% or 2.5%: this is designed to reflect

the fact that the long-run real rate of return on the UK capital stock has been between 2 and 2.5%.

Finally, bonds can be classified according to their default risk. UK Government bonds have a negligible risk of default, whereas the unsecured loan stock of private corporations has a much higher risk of default. The *default risk* (or *credit risk*) on a bond is usually assessed in the form of a *credit rating*. There are two main services providing credit ratings: Moody's and Standard & Poor's. These are shown in Table 1.1.

Table 1.1 Credit ratings on bonds

Moody's			Standard & Poor's
	Investment grade		
Smallest degree of risk – gilt-edged	Aaa	AAA	Highest rating: capacity to pay interest and repay capital extremely strong
High quality	Aa	AA	Strong capacity to service debt
Upper-medium grade: elements suggest possible future weakness	A	A	Strong capacity to service debt but susceptible to adverse changes in circumstances or economic conditions
Adequate security at present but may be unreliable over time; has speculative characteristics	Baa	BBB	Adequate capacity to service debt over time but adverse conditions likely to weaken capacity to service debt
	Non-investment grade		
Speculative: uncertain future	Ba	BB	Lowest degree of speculation
No desirable investment characteristics	B	B	Speculative
Poor standing: in default or in danger of going into default	Caa	CCC	Speculative
Highly speculative	Ca	CC	Highly speculative
Lowest rated: poor prospect of ever attaining investment grade	C	C	No interest is being paid
		D	In default
(*Grades B to Aa can be modified by 1, 2 or 3*)			(*Grades B to AAA can be modified by '+'or '−'*)

Pension funds hold all these types of bonds as well as overseas bonds; that is, foreign-currency domestic bonds issued by governments, municipal corporations and companies. However, some pension funds are prevented by their trust deeds from holding bearer bonds (which have no official record of ownership) or non-investment grade bonds.

Loans are non-negotiable debt instruments. Pension funds make long-term loans to local authorities, public and private corporations and other financial institutions. One such type of loan is a *mortgage*, which is used to finance property purchase. Loans are almost always secured with collateral provided by some form of lien. The loan can be on either a fixed or variable interest-rate basis. The term of the loan can be fixed; alternatively, there might be provision for early repayment.

We will illustrate the valuation of a bond using a straight government bond. A *straight bond* is a security that promises to pay a fixed interest or coupon payment every half-year, together with the return of principal or par value of the bond at maturity. For example, 8.75% Treasury Loan Stock 1997 was issued on 9 March 1987 and made 20 coupon payments of 4.375 on 1 September and 1 March each year together with a final payment of 104.375 on 1 September 1997.

The *fair price* of such a bond is given by the discounted present value of the cash flow stream, using the market-determined discount rate for a bond of this maturity and risk class (and also using *semi-annual* discounting)[3]:

$$\begin{aligned} P_0^{\mathrm{B}} &= \frac{d/2}{(1+\frac{r}{2})} + \frac{d/2}{(1+\frac{r}{2})^2} + \cdots + \frac{d/2}{(1+\frac{r}{2})^{2T-1}} + \frac{d/2}{(1+\frac{r}{2})^{2T}} \\ &\quad + \frac{B}{(1+\frac{r}{2})^{2T}} \\ &= \sum_{t=1}^{2T} \frac{d/2}{(1+\frac{r}{2})^t} + \frac{B}{(1+\frac{r}{2})^{2T}} \\ &= \frac{d}{r}\left[1 - \frac{1}{(1+\frac{r}{2})^{2T}}\right] + \frac{B}{(1+\frac{r}{2})^{2T}} \end{aligned} \tag{1.5}$$

where:

P_0^{B} = fair price of the bond
d = annual fixed coupon payment

[3] The first term in the last row of Equation (1.5) is the formula for the present value of a T-year annuity making semi-annual payments. For a derivation of the present value of an annuity making annual payments, see Appendix A of the book.

B = par value of the bond
T = number of *complete* years to maturity
r = market-determined discount rate or required rate of return on a bond with this risk class and maturity (as a proportion).

For Treasury Loan Stock 8.75% 1997, we have:

d = 8.75 per 100 nominal
B = 100
T = 9 years (i.e. the date of the calculation is 1 September 1988)
r = 9.54 (assumption).

The fair price of this bond is:

$$P_0^{\mathrm{B}} = \frac{8.75}{0.0954}\left\{1 - \frac{1}{\left[1 + \frac{1}{2}(0.0954)\right]^{18}}\right\} + \frac{100}{\left[1 + \frac{1}{2}(0.0954)\right]^{18}}$$
$$= 52.07 + 43.23$$
$$= 95.30.$$

The fair price of £95.30 is composed of the sum of the present value of the stream of coupon payments (£52.07) and the present value of the return of principal (£43.23).

The fair price of a perpetual or irredeemable bond (or consol) is given from (1.5) by setting $T = \infty$:

$$P_0^{\mathrm{B}} = \frac{d}{r}. \tag{1.6}$$

1.3 SHARES

There are several types of shares that can be held in the firm, as specified in the *memorandum* and *articles of association*. The most important type is *ordinary shares* (also called *common stock* or *equity*). Ordinary shareholders are the legal owners of the firm and have voting privileges, the right to receive dividends and subscription privileges in the event of new shares being issued. When a firm is first established, a certain number of shares will be *authorised*. They will have a *par value*, which in the UK is typically 25p. Some or all of the authorised shares will be issued to shareholders (and are called *issued shares* or *called-up shares*), with an issue price which can exceed the par value but cannot be less than

the par value. Any shares that are authorised but not issued are called *unissued shares*. All the issued shares will remain *outstanding* unless they are repurchased by the firm. Large firms will have their ordinary shares listed on the stock market, while the shares of smaller firms may be unlisted.

Most UK pension funds will hold most of their equity portfolios in UK *listed* shares (i.e. shares listed on the London Stock Exchange or the Alternative Investment Market (AIM)), but in recent years funds have begun investing in *unlisted* or *unquoted* shares. In some cases the risks are great, but so are the potential long-term rewards.

Pension funds have also invested heavily abroad since the ending of exchange controls in 1979. Initially, this was in overseas domestic equity markets, but in the second half of the 1980s, an international equity market began to develop and this has been used by pension funds. More than 600 shares worldwide have a significant international market. In the UK, equities are bought and sold on trading platforms called SETS (used for large-cap securities), SEAQ (for mid-cap securities) and SEATS plus (for small-cap and AIM securities).

The other important class of shares is *preferred shares*. Preferred shares have many of the characteristics of bonds. In particular, preferred shares offer a fixed dividend, like bonds and unlike ordinary shares. But preferred shares do not guarantee to deliver the dividend payment, and a preferred dividend need not be paid if the firm's earnings are not sufficient to fund it. But if this situation arises, preferred shareholders do not have the right to have the firm declared insolvent, unlike bondholders. It is this fact that makes preference shareholders legal owners of the firm (along with ordinary shareholders). There are several types of preferred shares. With *cumulative preferred shares*, all unpaid dividend payments cumulate and are paid when earnings are sufficient, unlike standard preferred shares where a dividend is lost if it is not paid in any given year. *Participating preferred shareholders* have the right to have their dividends increased above the fixed rate if the firm makes large profits. There are also *redeemable preferred* and *convertible preferred shares* (which are convertible into equity).

The most commonly used method for valuing shares is the *dividend discount model* (another example of a discounted cash flow model). Suppose that a firm pays dividends once a year. In reality they usually make two dividend payments per year: an interim and a final dividend. Suppose also that an investor intends to buy the share, hold it for one year and then sell it at the end of the year. He expects to receive a dividend

at the end of the year as well as the price for the share at that time. In order to make this return, he will be prepared to pay the following fair price for the share today:

$$P_0^S = \frac{E(d_1)}{1+r} + \frac{E(P_1^S)}{1+r} \tag{1.7}$$

where:

P_0^S = fair price of the share
$E(d_1)$ = expected (or forecast) annual dividend per share at the end of year 1
$E(P_1^S)$ = expected (or forecast) price of the share at the end of year 1
$E(\ )$ = expectations operator based on all current information (the average across all market participants)
r = market-determined discount rate or cost of capital or required rate of return on a firm with this risk class.

In (1.7), the return on the shareholding comprises an income element (d_1) and a capital gain element ($P_1^S - P_0^S$). Clearly, if the return is constant, then the higher the income element, the lower the capital gain and vice versa.

It must also be the case that:

$$E(P_1^S) = \frac{E(d_2)}{1+r} + \frac{E(P_2^S)}{1+r} \tag{1.8}$$

By substituting (1.8) into (1.7) we get:

$$P_0^S = \frac{E(d_1)}{(1+r)} + \frac{E(d_2)}{(1+r)^2} + \frac{E(P_2^S)}{(1+r)^2} \tag{1.9}$$

By repeatedly substituting equations like (1.8) for $E(P_2^S)$, $E(P_3^S)$, etc., into (1.9), we get:

$$P_0^S = \sum_{t=1}^{T} \frac{E(d_t)}{(1+r)^t} + \frac{E(P_T^S)}{(1+r)^T} \tag{1.10}$$

where d_t is the dividend per share in year t. As $T \to \infty$, (1.10) becomes:

$$P_0^S = \sum_{t=1}^{\infty} \frac{E(d_t)}{(1+r)^t} \tag{1.11}$$

since we assume that the second term on the right-hand side of (1.10) vanishes as $T \to \infty$, which will occur if $E(P_\infty^S)$ is finite (i.e. we rule out *speculative bubbles* of the kind that led to the dot.com boom in the late 1990s).

For preferred shares where the preferred dividend is known, (1.11) becomes:

$$P_0^S = \frac{d}{r} \tag{1.12}$$

which is identical to the formula for valuing perpetual bonds given in (1.6).

1.4 COLLECTIVE INVESTMENT VEHICLES

The following are the principal types of collective investment vehicle.

1.4.1 Unit trusts and open-ended investment vehicles

A *unit trust*, is a financial institution which invests in the securities of other companies. Its operations are subject to trust law rather than company law. A unit trust is formed by a trust deed made between the managers and the trustee. The managers operate and manage the unit trust's investments and charge a fee for doing so. The trustee, typically a bank or an insurance company, takes custody of the assets and keeps a register of unit-trust holders. A unit trust is not permitted to borrow funds to invest in securities; that is, it cannot engage in gearing.

The unit trust issues units, which represent claims on the assets of the unit trust. The units must be priced to equal the net asset value per unit in the unit trust. Unit trusts are *open-ended funds*, which means that they can create or cancel units as demand conditions permit. Unit trusts can specialise in different sectors of the market (e.g. shares or bonds, UK or Far East) or pursue different investment objectives (e.g. income, value or growth). Alternatively, a *balanced* unit trust will be widely invested across sectors and will aim to achieve high income with some capital appreciation.

In the past, authorised unit trusts could only invest in bonds and shares that were quoted on an approved market. The approved markets are the listed and unlisted securities markets of Europe, North America and the Far East. The investment powers of unit trusts were extended by the 1986 Financial Services Act. Authorised unit trusts can now

invest in property, options, futures and commodities. Previously, only unauthorised offshore unit trusts could make such investments. Unit trusts must still abide by any restrictions contained in their trust deeds. For example, typically no more than 5% of the fund can be invested in any one investment, and the fund can typically hold no more than 10% of the issued share capital of any company.

Pension funds will tend to invest in *exempt unit trusts*; that is, trusts that are exempt from both corporation tax and capital gains tax. Exempt unit trusts are a suitable investment vehicle for small pension funds, since this enables them to get the maximum benefits from diversification at the lowest cost. A particularly suitable vehicle that enables a small, or even medium-sized, fund to invest in property is the *exempt property unit trust*. Property is a 'lumpy' investment, and a unit trust is effectively the only way for a small fund to get a weighting in this sector.

Pension fund pooling vehicles (PFPVs) are unauthorised unit trusts approved by HMRC for managing the assets of both UK and overseas pension schemes. They are generally established by trust deed and require both a trustee and a custodian. They have not been authorised by the Financial Services Authority for sale to the general public, so they can be marketed to the trustees of exempt approved pension schemes, but not to individuals through personal pension schemes (Financial Services (Promotion of Unregulated Schemes) Regulations 1991)). Their purpose is to create a tax-efficient common investment fund: investors can transfer assets (other than land or buildings) into or out of a PFPV without incurring a liability to stamp duty or stamp duty reserve tax. This is not the case with standard unit or investment trusts. As gross funds, PFPVs are priced gross on a daily basis and they also have the advantage of accruing tax credits on a daily basis, which makes it easy to calculate the tax credits due to members both active and deferred. However, providers of PFPVs are not able to give investment advice. Group personal pension schemes (GPPSs) cannot be offered via PFPVs. PFPVs were designed specifically for multinational employers running defined benefit schemes.

Open-ended investment companies (OEICs) are like unit trusts but are based on company law rather than trust law. They are eligible, under the European Union UCITS Directive on collective investments in transferable securities, for sale on the continent, where trust law is unknown. The manager of an OEIC is known as an authorised corporate direct (ACD).

1.4.2 Investment trusts

An *investment trust* is, like a unit trust, a financial institution which invests in the securities of other companies. But, unlike a unit trust, it is not a trust at all; rather, it is a company, subject, as with all other companies, to the provisions of the Companies Acts. In particular, the 1980 Companies Act created a new type of public company, namely the *investment company*, and an investment trust is an example of one of these, since it issues shares to the public.

Investment trusts use their capital and reserves to invest directly in the securities of other companies. A shareholder in an investment trust, therefore, has an indirect interest in the underlying portfolio of securities. As with unit trusts, different investment trusts specialise in different sectors of the market or pursue different investment objectives.

In 1965, the *split-level investment trust* was introduced with two types of equity capital, *income shares* and *capital shares* (usually in the form of *zero-dividend preference shares*), and a fixed life (often of twenty years). During the life of the investment trust, the income shares receive all the income from the underlying portfolio and the capital shares are entitled to all the assets. When the company is liquidated, the income shares are paid out at their par value and the remaining value is paid out to the capital shareholders.

The main differences between investment trusts and unit trusts are as follows. Investment trusts are *closed-end funds*; that is, they have a fixed number of shares which can only be increased through a rights issue. Investment trusts can engage in *gearing* (i.e., borrowing to buy more securities), whereas unit trusts are not allowed to borrow. The prices of shares in investment trusts are determined by market forces, as with the shares of all companies. The prices of unit-trust units, in contrast, are set equal to the net asset value of the underlying portfolio. The prices of investment-trust shares can differ quite substantially from their net asset value. Typically they trade at a substantial discount to net asset value. Unit trusts generally distribute all their income, whereas investment trusts declare dividends, which may be low enough to leave some retained earnings in the company.

Investment trusts provide an alternative to unit trusts as a vehicle for pension funds, especially small pension funds, to engage in low-cost diversification. In addition, the discount to net asset value of most investment-trust share prices makes them a cheap way of buying securities.

1.4.3 Insurance products

Insured funds (or *life funds*) are the collective investment vehicles of life offices. Insured funds are used to invest the premiums of life office defined contribution pension schemes and other life products such as endowment policies. A number of financial services companies have established life offices in order to run their DC pension schemes, including GPPSs. The main advantage of doing this was to accrue for future tax credits on a daily basis within the unit price of the insured fund. However, a life office can only make tax reclaims on a quarterly basis, less frequently than a PFPV, which can also accrue tax credits on a daily basis. On the other hand, life offices enjoy full value-added tax (VAT) exemption on fund management fees and administrative charges, which is not the case with PFPVs. The life office route allows a provider to offer a wider range of services such as guaranteed funds, life cover and annuities. Nevertheless, life offices face certain investment restrictions, for example, they are unable to invest in unquoted securities, and they can only accept pensions business from UK exempt approved schemes.

Endowment policies are a combination of an accumulation fund and a term life assurance policy. The accumulation fund has returns allocated in the form of annual bonuses, which, once awarded, cannot be removed, and a terminal bonus, which generally represents a large proportion of the total return. Insured funds and endowment policies have the protection of the Financial Services Compensation Scheme, which will pay up to 90% of the policy value in the event of an insurance company becoming insolvent.

Traded endowment policies (TEPs) have recently begun to appear in the portfolios of small pension funds. Only around one-third of endowment policies reach maturity, the rest are usually cashed in early with the result that the remaining annual bonuses, as well as the terminal value of the policy, are lost. Traded endowments are a way of capturing the terminal value by assigning the benefits to a new investor for a fee, with the new investor continuing to make the premiums until maturity. The transfer of ownership takes place at auctions or via dealers. The policies are also tradable in a tertiary market with a bid-offer spread of around 6%. The proceeds at maturity are tax free to exempt approved schemes.

An *insurance bond* operates in a very similar way, depending on its structure, to either a unit trust or a with-profit policy. In the first case,

premiums are paid into the bond and these are used to buy a number of units in a fund that invests in a particular stock market or sector. The price of the bond is related to the total value of assets in the fund and will therefore rise and fall in line with movements in the market or sector. In the second case, the premiums earn cumulative smoothed returns through the allocation of annual bonuses (i.e., the 'profits' in 'with profits'), which cannot normally be withdrawn once they have been declared. However, in exceptional circumstances such as a stock market crash, a *market-value adjustment* (MVA) might be applied, which would lower the surrender value if the bond were encashed just after the crash.

The bonds are issued by insurance companies and come in two main types: *single-premium bonds* for lump sum investments and *regular-premium bonds*. A variation on the single-premium bond is the *distribution bond*, which pays an income, usually half yearly. Regular-premium bonds typically have two components: *initial* (or *capital*) units and *accumulation* (or *ordinary*) units. The initial units are used as a means of imposing a front-end charge of between 4 and 5%. This is achieved by cancelling the initial units. With accumulation units, all the income from the assets is reinvested; there is also an annual management charge. It is possible to switch between bonds offered by the same insurance company on a bid-price-to-bid-price basis. If a bond is surrendered before the end of the original term, its value will be calculated on the basis of the ruling bid price less a surrender penalty. The income and capital gains on insurance bonds are taxed at the basic rate. Higher rate taxpayers can take tax-free withdrawals of up to 5% a year on a cumulative basis for up to 20 years, but if the bond is cashed, any profit is taxed at a rate equal to the difference between the higher and basic rates of tax. Insurance bonds can be used by pension schemes, but pension contributions will be placed in *exempt units*, which will be free of income and capital gains taxes. Lump-sum pension contributions can also be placed in single-premium bonds, but not those that make distributions.

1.4.4 Exchange-traded funds and guaranteed growth funds

Exchange-traded funds (ETFs) are tracker funds with shares traded on the stock exchange. They began in the USA in 1993. There is no stamp duty payable and management fees are in the range 0.35–0.50% per annum, which is higher than a typical institutional investor would have to pay for index tracking (about 0.2% per annum). Barclays Global Investors calls its EFTs iShares: iFTSE 100 and iFTSE ex UK.

Guaranteed growth funds (or *guaranteed funds*) guarantee to return a minimum fund value (e.g. 98% of the original investment) whatever happens to the value of the underlying investments. They come in two types. The first type is a cash- or bond-based investment that uses part of the initial investment, together with the income generated by the cash or bond portfolio, to buy call options on an equity index, such as the FTSE 100 index; in this form the product is sometimes called an *equitised cash portfolio*. The combination of the bonds plus the call options gives complete downside protection against falls in the value of the stock market, but leaves open some upside potential if the stock market rises. The second type of guaranteed fund is equity-based and uses part of the initial investment, together with the income generated by the equity portfolio, to buy put options on an equity index, such as the FTSE 100 index. The combination of the underlying equities plus the put options on the stock market index gives complete downside protection against falls in the value of the stock market, but leaves open some upside potential if the stock market rises. The value of the guaranteed equity product in this second case equals the sum of the values of the equities and the put options held in the portfolio.

1.5 REAL ASSETS

So far we have examined the main *financial assets* that a pension fund might hold in its portfolio. But it can also invest in *real assets*: principally property, land and collectibles.

1.5.1 Property

The main classes of *property* that pension funds invest in are industrial, commercial and office property. They do not tend to invest in residential property. Large funds prefer direct property investment, whereas small funds prefer indirect investment through exempt *property unit trusts* (e.g. the Pension Fund Property Unit Trust).

The main objectives of direct property investment are the attainment of a stable rental income and an appreciation of capital value. Large funds tend to select their investments to meet the latter objective, whereas small funds appear to be more concerned with the former. All funds prefer to let their property to substantial tenants, mainly public companies and public authorities, and this preference influences the type of property

invested in. In other words, the tenant is as important as the property from the investment viewpoint.

Originally, pension funds invested in the equity of property companies, but since the 1960s they have begun to invest directly in property, preferably freehold property, but leasehold property with good capital-appreciation prospects is also acceptable. Direct investment offers more influence over both the type of property purchased and the subsequent management of the property than does investment in property-company shares. Also initially, property holdings were confined to the UK, but with the ending of exchange controls in 1979, pension funds started investing in property overseas, especially in the USA.

In contrast with financial assets, real assets are differentiated by a large number of characteristics. The differences between the shares in two different companies are usually quite small, but the differences between two buildings can be enormous. It is, therefore, important to specify the set of characteristics underlying property investment. Location, design and type and conditions of tenure are three of the most important characteristics of any property. Of these, location is by far the most significant factor in letting property. If the location of a building is good, it can be let even if the design is inadequate. Similarly, a building can become difficult to let because the centre of gravity of activity has shifted in relation to its location. A typical example is the building of a new shopping centre, which reduces the popularity of a traditional shopping zone. The design of a building (both internal and external) also has an important influence on rental values. This is because a poorly designed building or, just as important, a building with an out-of-date design, might have to be internally or externally restructured if it is to be let. Rental values also depend on the types and conditions of tenure: freehold or leasehold, length and nature of leasehold, rental review periods, and so on.

Depending on its location, design and tenure conditions, property is categorised as either prime or secondary. *Prime property* is in the best location, is well-designed and in excellent condition, is freehold and let to a first-class tenant on a lease with frequent review periods. At any one time only about 1–2% of property on the market is prime property; the remainder is *secondary property*, and so is, to some extent, less desirable in terms of these three characteristics. This will be reflected in lower rental values.

Offices, shops and industrial property have different factors that should be considered when designing the investment property portfolio. With offices, the most important factor is ease of access for staff. More

than one-quarter of UK workers work in offices, and half of these are in the Southeast. Proximity to transport routes has a large effect on rental values. Good design is also essential, the most important factors being: modern and sound construction, good lateral and vertical communication, efficient heating and ventilation, flexibility in terms of use of space and adequate servicing, including computing and telecommunications facilities. With shops, the most important factors are: ease of access for customers and delivery vehicles and good storage capabilities. The location restrictions for shops are less severe than for offices, since profitable shopping sites are not confined to central urban locations. With shopping types ranging from hypermarkets down to individual units, the most important type, from the investment viewpoint, is the multiple-shop complex occupied by national chain-store tenants. Specific features of such complexes that contribute to the property's value are good customer access (e.g. car-parking facilities), good pedestrian flow (otherwise customers are not attracted to shopping units on upper levels), good tenant mix (e.g. cafeteria services attract customers to the complex even though they do not maximise rental income on a unit basis), good shape, layout and upper-level access (rectangular units with wide frontage attract the most walk-in customers, while escalators and lifts are needed to attract customers to upper levels; atriums give a sense of openness, even though they are otherwise a 'waste of space') and good access by delivery, refuse and other services.

Industrial property covers light-industrial premises, heavy-industrial buildings and warehouses. Only the first and last categories make suitable investments for pension funds. Heavy-industrial buildings are generally purpose-built by the companies that intend to use them for production purposes. The main criterion for industrial property is the ease with which raw materials can be moved in and finished goods moved out. This suggests that light-industrial property and warehouses with good rail and road connections close to conurbations will make the most desirable investments for pension funds.

Given the heterogeneous nature of property, it is probably not surprising that the property portfolios of pension funds also tend to be very diverse. While many have a general mix of property, some concentrate on office and retail property, with yet others specialising in industrial property.

Property has advantages and disadvantages compared with other investments. The main disadvantages are liquidity and management time and costs. Direct purchasing of property costs 5.5% (including stamp

duty), while spreads with property unit trusts are 6–8%. The main advantages of property compared with other assets are high income returns protected by upward-only rental reviews, low volatility of returns and low, or even negative, correlation with other assets, making property an excellent asset for diversification purposes.

Property is valued by discounting projected rental income. The discount rate used is typically linked to that of a high-quality corporate bond.

1.5.2 Land

In the 1970s, pension funds were substantial investors in *agricultural land*, especially in the rented sector rather than the vacant-possession sector. They acquired farms with sitting tenants and entered into sale and lease-back agreements.

Agricultural land tends to be an attractive investment when inflation is high: the appreciation in land values more than adequately compensates for the low net yields experienced with this type of investment. But if the rate of inflation falls, financial assets tend to generate higher real returns than land, and without the problems associated with managing farm tenants. This has tended to reduce the attractiveness of investing in agricultural land, and some pension funds have unloaded some of the lower-quality land from their portfolios.

1.5.3 Collectibles

Collectibles is the name given to small physical assets whose value is expected to increase over time. Collectibles therefore include works of art, precious metals, porcelain, jewellery, carpets, furniture, rare stamps and coins, antiquities, vintage wines, and so on. Collectibles, mainly in the form of works of art, have been a controversial part of pension fund portfolios ever since they first started to be collected in the 1970s. The most notable collector was the British Rail Pension Fund, which invested £40m (or 2% of its funds) in 2300 items from twenty-two categories, mainly paintings, coins, china and silver, between 1974 and 1978, and hence earned a reputation for being 'one of Europe's greatest art patrons since the Medici' (Godfrey Barker, *Daily Telegraph*, 28 February 1987).

The British Rail Pension Fund's art collection began in 1974, during the depth of the London equity-market crash, with exchange controls preventing investment abroad, no index-linked gilts available to insulate

the fund from soaring inflation at home and an increase in salaries of 31%. The art collection was an attempt to generate the real returns from physical assets that had apparently disappeared from the holding of financial assets. It was, in the words of the art consultant to the fund, 'a dramatic measure taken in a moment of crisis'.

Despite being copied by many companies throughout Europe and the USA, the British Rail Pension Fund art collection has had a controversial history. First, there was the issue about whether the collection constituted trading or investment. Under HMRC rules, pension funds can only get tax relief on investments, not on trading. The collection was eventually accepted as an investment for the purposes of obtaining tax relief. Second, there are the costs of storage and insurance, which are much higher than for financial assets. Third, there is the risk of making poor investment choices that are subsequently difficult to undo. The British Rail fund subsequently admitted that it felt it had diversified into too many fields. Fourth, collectibles cannot be disposed of very rapidly, making them a relatively illiquid investment. Fifth, there are uncertainties about valuation. These investments generate no income, and the return comes entirely from capital appreciation. Given the costs of holding them, the gross return on collectibles has to exceed that on financial assets by a sizeable margin before it dominates the return on financial assets.

The BR Pension Fund decided to sell its collection, beginning in 1987, mainly for the reasons just discussed. In the event it achieved a compound rate of return of 15% per annum. This compared with an average return on all pension-fund investments over the same period of 15.1% per annum and a return on equities of 18.7% per annum. It turned out that equities had been the better investment, but BR argued that this could not have been known in 1974.

1.6 DERIVATIVES

1.6.1 Forwards and futures

Forward and futures contracts are examples of *derivative* instruments; that is, they are derivatives of an underlying *spot-* or *cash-market* security.

A *forward contract* is an agreement between two counterparties that fixes the terms of an exchange that will take place between them at some future date. The contract specifies: what is being exchanged (for example, cash for a good, cash for a service, a good for a good, a good

for a service, cash for cash, and so on), the price at which the exchange takes place and the date (or range of dates) in the future at which the exchange takes place. In other words, a forward contract locks in the price today of an exchange that will take place at some future date. A forward contract is, therefore, a contract for *forward delivery* rather than a contract for immediate or *spot* or *cash delivery*, and generally no money is exchanged between the counterparties until delivery.

Forward contracts have the advantage of being tailor-made to meet the requirements of the two counterparties, in terms of both the size of the transaction and the date of forward delivery. However, one disadvantage of a forward contract is that it cannot be cancelled without the agreement of both counterparties. Similarly, the obligations of one counterparty under the contract cannot generally be transferred to a third party. In short, a forward contract is, in general, neither very liquid nor very marketable; however, some forward markets, for example the forward currency markets in London, are very liquid. Another disadvantage is that there is no guarantee that one counterparty will not default and fail to deliver his obligations under the contract. This is more likely to occur the further away the spot price is at the time of delivery from the price that was agreed at the time the contract was negotiated (that is, from the forward price). It will always be the case that it would have been better for one of the counterparties not to have taken out the forward contract but to have waited and transacted in the spot or cash market at the time called for delivery. If the spot price is higher than the forward price, the counterparty taking delivery (the buyer) gains and the counterparty making delivery (the seller) loses, and vice versa when the spot price is below the forward price. The greater the difference between the spot and forward prices, the greater the incentive for the losing counterparty to renege (that is, the greater the *credit risk*).

A *futures contract* is also an agreement between two counterparties that fixes the terms of an exchange that will take place between them at some future date. But it is very different from a forward contract and has been designed to remove many of the disadvantages of forward contracts. But the cost of achieving this has been to remove some of the advantages of forward contracts as well.

Futures contracts are standardised agreements to exchange specific types of good, in specific amounts, and at specific future delivery or maturity dates. For example, there might be only four contracts traded per year, with the following delivery months: March, June, September and December. This means that the details of the contracts are not negotiable

as with forward contracts. However, the big advantage of having a standardised contract is that it can be exchanged between counterparties very easily. The number of contracts outstanding at any time is known as the *open interest* at that time.

The value of a futures or forward contract can be determined using the *cost-of-carry* (or the *cash-and-carry*) *model*. This is an example of an *arbitrage-free* or *risk-neutral pricing model*. Since futures contracts do not generate any cash flows prior to maturity, we cannot use a discounted cash flow model to value them. Instead, we use a model in which arbitrage strategies involving futures and cash-market positions are established and the fair (or arbitrage-free) futures price is such that riskless arbitrage profits cannot be made from these strategies. An *arbitrage strategy* is one in which the investor uses none of his own wealth (i.e. he borrows any funds needed to set up the investment strategy) to establish a set of investments that involve no risk and from which the investor hopes to generate a riskless positive return. In an efficient financial market, the futures price will quickly adjust to eliminate such a money machine or free lunch and we will have found the fair futures price.

Suppose that an individual can undertake one of the following two investments, one in the cash market and one in the futures market. He could borrow enough to buy an asset in the cash market, hold on to it for T years (earning any income, but bearing any *carry costs*[4], including interest on borrowed funds involved), and then sell it in the cash market and also repay the loan with interest. Alternatively, he could sell a futures contract on the asset at the current futures price and, at the end of T years, buy the asset in the cash market to deliver it into the futures market to fulfil the terms of the contract.

The profit under the second strategy is:

$$\text{Profit from strategy 2} = P^{\mathrm{F}} - P_T^{\mathrm{S}} \tag{1.13}$$

where:

P^{F} = current futures price for delivery of the asset in year T.
P_T^{S} = spot price of the asset in year T.

Clearly, in a world with complete certainty $P^{\mathrm{F}} = P_T^{\mathrm{S}}$, the futures price must equal the actual future spot price. So the profit from this strategy

[4] Carry costs are the costs associated with buying, holding and disposing of a security, such as the bid-offer spread, brokerage costs, taxes, insurance, storage and interest on the funds borrowed to buy the asset.

will be zero on the maturity date T of the contract. There are no cash inflows or cash outflows during the life of the contract. Also, there are no carrying costs with a futures contract; all the carrying costs are associated with the cash-market transactions, but they are not incurred until the end of the period.

The profit under the first strategy is:

$$\text{Profit from strategy 1} = P_T^{\text{S}} - P^{\text{S}}(1 + rT) + dP^{\text{S}}T \tag{1.14}$$

where:

P^{S} = current spot price of the asset
P_T^{S} = spot price of the asset in year T
r = annual carry costs, including interest on loan (as a proportion)
d = gross annual yield from holding cash asset (as a proportion).

In (1.14) we assume that simple interest and not compound interest is used (otherwise we would need to use $(1 + r)^T$ rather than $(1 + rT)$) and that carry costs in the cash market are proportional to price. The cost of carry is $(r - d)$ and this can be positive or negative.

Both strategies achieve the same outcome, namely the sale of an asset in T years' time; both strategies use none of the individual's own wealth and both strategies are riskless. Two identical strategies using no wealth and involving no risk (i.e. arbitrage strategies) should, in equilibrium, generate the same profit, and that profit should be zero. We know that strategy 2 generates zero profit, and strategy 1 should also generate the same zero profit.

By equating (1.13) and (1.14), we can derive the fair futures price P_0^{F}:

$$\begin{aligned} P_0^{\text{F}} &= [1 + (r - d)T)]P^{\text{S}} \\ &= P^{\text{S}} + (r - d)T.P^{\text{S}} \end{aligned} \tag{1.15}$$

The fair futures price is equal to the current spot price *plus* the cost of carry, and so is derivative of the spot price: this is why a futures contract is known as a derivative security. The difference between the futures and spot price is known as the *basis*, and it is clear from (1.15) that the basis, is equal to the cost of carry:

$$\begin{aligned} \text{Basis} &= P_0^{\text{F}} - P^{\text{S}} \\ &= (r - d)T.P^{\text{S}} \\ &= \text{Cost of carry} \end{aligned} \tag{1.16}$$

The basis will be positive (this situation is known as *contango*) if the cost of carry is positive and negative (this situation is known as *backwardation*) otherwise.

1.6.2 Options, warrants and convertibles

The effect of a futures contract is to fix today the future price of some security. In other words, the price at which a security is traded in the future is locked in today. For many purposes this may be exactly what is required, but for others it is overly restrictive. An investor may be more certain of price rises than price falls, but would nevertheless like to protect against price falls. The solution in this case is to buy an option contract, in this case a put option contract.

An *option* gives to its *holder* the right, but not the obligation, to buy or sell an underlying security at a fixed price (the *exercise price* or *strike price*) at or before a specific date (the *maturity date* or *expiry date*). This right is given by the issuer or *writer* of the option. A *call* option gives the right, but not the obligation, to *buy* the security, while a *put* option gives the right, but not the obligation, to *sell* the security. In order to give effect to the right to buy or sell, the option has to be *exercised*. A *European* option can only be exercised on the expiry date, whereas an *American* option can be exercised at any time before the expiry date. In return for the insurance offered by the option, a price (called the *option premium*) has to be paid.

If, on the expiry date of the option, the option is *out-of-the-money* (which will occur in the case of a call if the price of the underlying is below the exercise price and in the case of a put if the price of the underlying is above the exercise price), it will expire worthless. If, however, on the expiry date of the option, the option is *in-the-money* (which will occur in the case of a call if the price of the underlying is above the exercise price and in the case of a put if the price of the underlying is below the exercise price), it will expire equal to its *intrinsic value* (the difference between the price of the underlying and the exercise price).

Figure 1.1 shows the profit and loss profile on two different dates of a call option on a share with an exercise price of 125p. The dashed line shows the P/L on 1 April when the underlying share is trading at 115p and the option is trading at 3p. If, on 1 April, the share price rises, so will the option price (along the dashed line) and the investment will show a

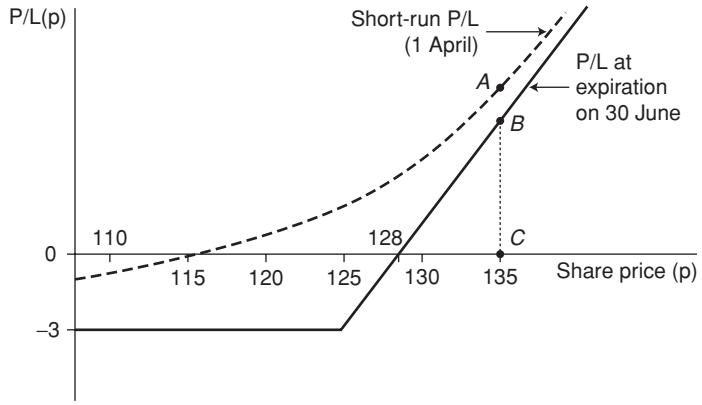

Figure 1.1 Profit and loss profile to the buyer of a call option

profit. The solid line shows the P/L on the expiry date of 30 June. If the share price is at or below 3p, the option will expire worthless and the position will show a net loss of 3p. The position breaks even with a share price of 128p and the profit on the option increases penny for penny for every penny that the share price ends up above 125p on 30 June. The vertical gap between the dashed and solid lines in Figure 1.1 is called the *time value* of the option. The option price is the sum of the intrinsic value and the time value. With the share price trading at 115p, the time value is 3p (the intrinsic value of the option is zero on 1 April, since the share is trading below the exercise price). The time value is the price that the buyer pays for the chance that the option ends up in-the-money on the expiry date of the option. The time value itself falls to zero on that date. Only intrinsic value remains and this will equal either zero if the share price is below 125p or the difference between the share price and the exercise price if the share price is above 125p. Figure 1.2 shows a similar P/L profile for a put option costing 21p on the same share.

An *equity warrant* is an option issued by a firm to purchase a given number of shares in that firm at a given exercise price, at any time before the warrant expires. If the warrant is exercised, the firm issues new shares at the exercise price and so raises additional finance. A *bond warrant* is an option to purchase more of the firm's bonds. A warrant generally has a longer maturity than a conventional option (for example, five years), and some warrants are perpetual.

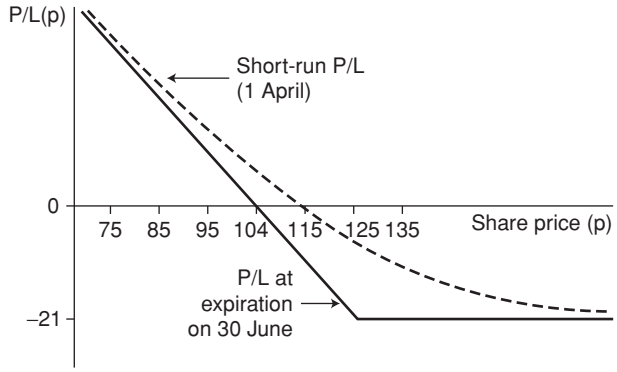

Figure 1.2 Profit and loss profile to the buyer of a put option

Warrants are usually attached to debt instruments such as bonds (known as *host bonds*). Sometimes they are detachable from these instruments and so can be traded separately; sometimes they are non-detachable. Equity warrants generally do not carry any of the rights of shareholders until they are exercised: for example, they pay no dividends and do not come with voting rights. However, warrant-holders are protected from changes to the underlying share price such as those resulting from stock splits or stock dividends through a corresponding adjustment to the exercise price of the warrant (the same is true of ordinary options). Bond warrants can either be exercised into the same class of bonds as the host bond or into a completely different class of bond.

A *convertible* is a bond (or sometimes a preferred share) that is convertible at some future date into ordinary shares (in the case where the convertible is issued by a corporation) or into another bond, known as a *conversion bond* (in the case where the issuer is a government). The conversion is at the option of the holder of the convertible, although the conversion can be forced if the convertible is also callable by the firm. A company-issued convertible is therefore a means of transforming debt into equity at some future date.

An arbitrage-free or risk-neutral model is used to value options (Cox *et al*., 1979). Consider a European call option on a security that makes no cash payments (e.g. a non-dividend-paying share) where the security price follows a stationary binomial stochastic process, so that at the end of the period it can be higher or lower than at the start of the period, but

involves no trend (i.e., is stationary over time). We assume the following notation:

P^S = current security price
p = *real world probability* that security price will rise
$1-p$ = *real world probability* that security price will fall
r = risk-free rate of interest (e.g. $r = 0.1$)
u = multiplicative upward movement in security price, $u > 1+r$
d = multiplicative downward movement in security price, $d < 1$

With these assumptions, the security price will increase to uP^S with probability p, or decrease to dP^S with probability $1-p$. It is necessary that $u > (1+r) > d$, otherwise there would be opportunities for riskless arbitrage.

Now we consider a call option on the security with an exercise price of X. The expiry value of the option has to be either $P_u^C = \max(0, uP^S - X)$ probability p or $P_d^C = \max(0, dP^S - X) = 0$ with probability $1-p$. What is the value of the call at the beginning of the period?

To answer this question, we need to examine the return on a *riskless hedge portfolio* constructed from a long position in the underlying security and a short position in h units of the call option (where h is the *hedge ratio*). The value of the riskless hedge is given by:

$$V^H = P^S - hP^C \tag{1.17}$$

We can use the fact that a riskless hedge portfolio must have the same terminal value in all states:

$$uP^S - hP_u^C = dP^S - hP_d^C \tag{1.18}$$

in order to determine the appropriate hedge ratio, h, i.e. the number of call options to be written against the underlying security:

$$h = \frac{P^S(u-d)}{P_u^C - P_d^C} \tag{1.19}$$

The riskless hedge portfolio has a terminal value of $uP^S - hP_u^C = dP^S - hP_d^C$ in all states of the world, so that any increase in the value of the share component is always exactly offset by the fall in the value of the option component. This is why the valuation model is called a risk-neutral model: two risky securities are combined together in such a way that the combined payoff from the two securities is riskless or risk-neutral.

Because the hedge portfolio is riskless, it must be the case that the current value of the portfolio can be found by discounting the known terminal value by the riskless rate of interest:

$$P^{\mathrm{S}} - hP^{\mathrm{C}} = \frac{uP^{\mathrm{S}} - hP_u^{\mathrm{C}}}{1+r} \tag{1.20}$$

Substituting (1.19) into (1.20) and solving for P^{C}, we get the fair price of the call option (P_0^{C}):

$$P_0^{\mathrm{C}} = \frac{q.P_u^{\mathrm{C}} + (1-q).P_d^{\mathrm{C}}}{1+r} \tag{1.21}$$

where:

$$q = \frac{1+r-d}{u-d} \tag{1.22}$$

is the *risk-neutral probability* that the security price will rise and that the option will expire worth P_u^{C}. Note that q does not depend on p, the real world probability that the security price will rise during the period. From (1.21), it is clear that the fair option premium is simply the discounted value of the expected expiry value of the option using risk-neutral probabilities (i.e. the discounted value of the probability-weighted sum of the values of the options in the two possible states of the world).

The option price depends on five factors: the current security price (P^{S}), the exercise price (X), the time to expiry ($T = 1$ in the one-period model discussed above), the risk-free interest rate (r) and the variance of the security price (σ^2). The variance of the security price, which depends on u, d and p, can be found as follows. The expected terminal value of the security price is:

$$E(P_T^{\mathrm{S}}) = pP_u^{\mathrm{S}} + (1-p)P_d^{\mathrm{S}} \tag{1.23}$$

and the variance is (assuming zero covariance since u and d are independent of each other):

$$\mathrm{Var}(P_T^{\mathrm{S}}) = p[P_u^{\mathrm{S}} - E(P_T^{\mathrm{S}})]^2 + (1-p)[P_d^{\mathrm{S}} - E(P_T^{\mathrm{S}})]^2 \tag{1.24}$$

If the annual standard deviation[5] of the return on a security is given by σ, then the values of u and d consistent with this are given respectively

[5] For a definition and interpretation of standard deviation, see the appendix at the end of this chapter.

by:

$$u = e^{\sigma} \quad \text{and} \quad d = \frac{1}{u} = e^{-\sigma} \tag{1.25}$$

If the time horizon differs from one year and extends to, say, T years, then we have:

$$u = e^{\sigma\sqrt{T}} \quad \text{and} \quad d = e^{-\sigma\sqrt{T}} \tag{1.26}$$

An option is the only security whose price increases when there is an increase in risk, as represented by an increase in the standard deviation of the return on a security; this makes options very valuable trading instruments in volatile markets.

The binomial model assumes a discrete-time stationary binomial stochastic process for security price movements. In the limit, as the discrete-time period becomes infinitely small, this stochastic process becomes a *diffusion process* (also called a *continuous-time random walk* or *geometric Brownian motion*). This was the process assumed by Black and Scholes (1973) in their famous derivation of the option-pricing formula. As with the binomial model, Black and Scholes began by constructing a riskless hedge portfolio, long in the underlying security and short in call options. This portfolio generated the riskless rate of return, but the internal dynamics of the portfolio were driven by the diffusion process for the security price. The structure of the hedge portfolio could be put into a form that is identical to the heat equation in physics. Once this was recognised, the solution to the equation was easily derived.

The Black–Scholes formula for the fair price of the call option is:

$$P_0^{\mathrm{C}} = P^{\mathrm{S}} N(d_1) - X e^{-rT} N(d_2) \tag{1.27}$$

where:

P_0^{C} = fair price of call option
P^{S} = current price of security
X = exercise price
r = riskless rate of interest
T = time to expiry in fractions of a year (e.g. one quarter, $T = 0.25$; one year, $T = 1.00$)
σ = instantaneous standard deviation (or volatility)

$$d_1 = \frac{\ln(P^S/X) + rT}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T} = \frac{\ln(P^S/Xe^{-rT})}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$N(d_i)$ = cumulative probability distribution for standard normal variate from $-\infty$ to d_i.

The price of a European put option on a security that makes no cash payments is given by a relationship known as *put–call parity* (Stoll, 1969).

$$P_0^P = P_0^C - P^S + Xe^{-rT} \tag{1.28}$$

1.6.3 Swaps

Swaps (or *contracts for differences*) are securities that involve the exchange (of cash flows) on two or more different securities. Most swaps involve combinations of two or more cash-market securities (e.g. a fixed interest-rate security combined with a floating interest-rate security, possibly also combined with a currency transaction). However, there are also swaps that involve a futures or forward component, as well as swaps that involve an option component.

Pension funds in the UK have been involved in swap agreements since the late 1960s, when they took out parallel or back-to-back currency loans to finance their overseas investments in a way that was compatible with UK exchange control regulations then in force. The loan operated as follows. There was a matching agreement between a UK investor and an overseas counterparty, whereby the counterparty purchased overseas assets for the UK investor, who, in turn, purchased an equivalent amount of sterling assets for the foreign institution. While it involved no direct exchange of principal, this method of overseas investment was clearly very cumbersome and was made even more complicated in the period before June 1979 by additional Bank of England regulations, which required every $100 of currency loan to be covered by $115 of dollar assets, with the additional dollar assets being purchased with investment currency at a premium above the official rate.

The back-to-back currency loan was the precursor of the currency swap, the first example of this being between IBM and the World Bank in 1981. The swap market can be said to date from this time. The main types of swap are interest-rate swaps, basis swaps, fixed-rate currency

swaps, currency-coupon swaps and asset swaps. All these swaps work on the principle that different institutions have different comparative advantages and that, as a result, there can be gains from the two institutions trading with each other. We will discuss each of them in turn.

Interest-rate swaps are the most important type of swap in terms of volume of transactions. An interest-rate swap is an agreement between two counterparties to exchange fixed interest-rate payments for floating interest-rate payments in the same currency calculated with reference to an agreed notional amount of principal (hence the alternative name, contract for differences). The principal amount, which is equivalent to the value of the underlying assets or liabilities that are 'swapped', is never physically exchanged but is used merely to calculate interest payments. The purpose of the swap is to transform a fixed-rate liability into a floating-rate liability and vice versa. The liability so transformed is, therefore, a synthetic security comprising the difference between two cash-market liabilities. The floating rate that is used in most interest-rate swaps is calculated with reference to LIBOR (the London inter-bank offer rate). Most interest-rate swaps are in US dollars, but those in yen, euros, sterling and Swiss francs are also important. Interest-rate swaps have a similar structure to interest-rate futures contracts, in the sense that the terms of the future obligations under the swap are determined today.

The motivation for an interest-rate swap is to exploit a comparative advantage and to make a gain from trade. To illustrate this, we will consider Figure 1.3, which shows the interest-rate swap established between Bank A and Bank B with funds provided by two companies, Company I and Company II. Bank A has a credit rating of AAA while B has one of BBB. The cost of borrowing directly from the companies is as shown in Table 1.2.

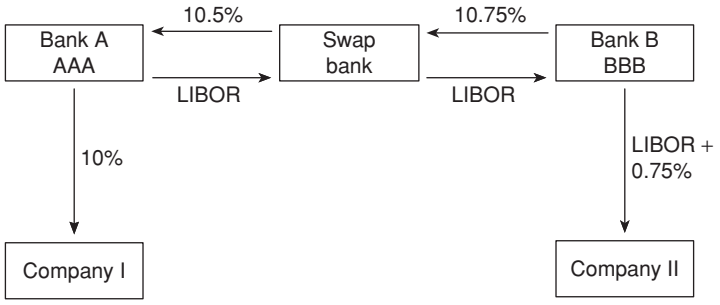

Figure 1.3 Interest-rate swap

Table 1.2 The cost of borrowing from Companies I and II

	Bank A (AAA)	Bank B (BBB)	Comparative advantage of A over B
Fixed-rate loans	10%	12%	2%
Floating-rate loans	LIBOR + 0.25%	LIBOR + 0.75%	0.5%

While A has an absolute advantage in borrowing both fixed-rate and floating-rate funds, it has a *comparative advantage* in fixed-rate loans, giving B a comparative advantage in floating-rate loans. A swap is therefore feasible if A would prefer to have a floating-rate loan and B would prefer to have a fixed-rate loan. Company I is willing to make fixed-rate loans to (or purchase the bonds of) AAA banks at a fixed rate of 10%. Company II is willing to make variable-rate loans to BBB companies at LIBOR + 0.75%.

If the swap is executed using the services of a swap bank intermediary, Bank A will make floating-rate payments to Bank B and, in return, B will make fixed-rate payments to A, as indicated in Figure 1.3. The effect of the swap on each counterparty involved might be as follows:

Bank A:	Borrows fixed at	10%
	Receives from swap bank	(10.5%)
	Pays to swap bank	LIBOR
		LIBOR − 0.5%

and so Bank A effectively borrows floating-rate funds (i.e. has created a synthetic floating-rate loan) at LIBOR − 0.5%, which is less than the rate at which it can borrow these funds directly from the market (i.e. LIBOR + 0.25%, a saving of 0.75%).

Bank B:	Borrows floating at	LIBOR + 0.75%
	Receives from swap bank	(LIBOR)
	Pays to swap bank	10.75%
		11.5%

and so Bank B effectively borrows fixed-rate funds (i.e. has created a synthetic fixed-rate loan) at 11.5%, which is less than the rate at which it could borrow such funds directly from the market (i.e. 12%, a gain from trade of 0.5%).

The swap bank:	Pays A	(10.5%)
	Receives from A	LIBOR
	Pays B	(LIBOR)
	Receives from B	10.75%
		0.25%

and so the swap bank makes 0.25% out of the deal.

Basis swaps are the same as floating/floating interest-rate swaps. This means that floating-rate payments calculated on one basis are swapped for floating-rate payments on another basis. The main examples are: the US dollar prime rate–US dollar LIBOR swap; US dollar commercial paper–US dollar LIBOR swap; and the 1-month US dollar LIBOR–6-month US dollar LIBOR swap.

Currency swaps are agreements to exchange payments in one currency for those in another. Sometimes the principal is exchanged as well as the interest payments. The structure of a currency swap is similar to a forward contract or futures contract in foreign exchange. There are two types of currency swap: fixed-rate currency swaps and currency-coupon swaps.

Fixed-rate currency swaps have three main components: the principal amounts, the exchange rate and two fixed interest rates. At the beginning of the swap, two principal amounts are 'exchanged' between the two counterparties at an agreed exchange rate. The exchange rate is usually the spot rate (the average of the bid and offer rates). This exchange of principal can either be 'notional' (no physical exchange takes place) or 'real' (a physical exchange is made). In either case, the significance of the principal is that it is used to determine both the interest payments under the swap and the re-exchange of principal when the swap matures. The interest payments that are made depend on both the principal amounts and the interest rates that are fixed at the beginning of the swap. On maturity, the principal amounts are 're-exchanged' between the two counterparties at the initial exchange rate. Fixed-rate currency swaps, therefore, allow fixed-rate liabilities in one currency to be transformed into fully-hedged fixed-rate synthetic liabilities in another currency.

The other type of currency swap is the *currency-coupon swap* or *cross-currency interest-rate*. It is a combination of an interest-rate swap and a currency swap. The format of the swap is identical to that of a fixed-rate currency swap with both initial and final exchange of principal (at the initially agreed exchange rate), but one or both of the interest payments

involved are on a floating-rate basis. So, for example, fixed-rate dollars could be swapped for floating-rate sterling.

Asset swaps combine an asset and a swap to create a synthetic asset. So, for example, a fixed-rate asset can be converted into a floating-rate asset in the same currency or in a different currency.

These are the main types of swap. But other, more complicated, swaps have been executed. *Forward swaps* are swaps that are executed on a future date but the terms are agreed today. A *swaption* is an option on a swap giving the holder the right, but not the obligation, to execute the swap on a future date with the terms agreed today. A *callable swap* gives the fixed-rate payer the right to terminate the swap before the maturity date. An *index swap* is one in which the payments depend on an index, such as the retail price index, a stock index or an index of bond prices. A *zero-coupon swap* is one in which the fixed-rate payments are compounded over the life of the agreement at some agreed rate of interest and paid on the maturity date.

1.6.4 Forward-rate agreements

Forward-rate agreements (FRAs) are equivalent to forward contracts in short-term interest-rate swaps and so combine many of the features of forward or futures contracts and of swaps. In other words, FRAs are equivalent to synthetic forward-swap contracts. An FRA is a contract between two counterparties to swap short-term interest-rate payments over an agreed period at some date in the future. The buyer of an FRA locks in a fixed rate of interest, while the seller locks in a floating rate. As with a standard swap, no exchange of principal is involved. Instead, on the settlement date of the FRA, one counterparty makes a single cash payment to compensate the other counterparty for any difference between the agreed interest rate and the spot interest rate at that time.

The market in FRAs began in the early 1980s as an offshoot of the inter-bank market in forward/forward interest-rate agreements. Most FRAs (about 90%) are in sterling or dollars, although there is a growing market in euro and yen FRAs. Virtually all FRAs are quoted in LIBOR. Most are for three-sixes (that is, three-month LIBOR in three months' time), but there are other combinations available, for example, nine-fifteens (6-month LIBOR in nine months' time).

1.6.5 Synthetic securities

Derivatives can also be used to construct *synthetic securities*. These are securities constructed to replicate the payoff pattern of an underlying cash-market security.

Suppose the aim is to replicate the payoff pattern of the shares in the FTSE 100 index. This could be achieved by buying all the shares in the FTSE 100 index with the appropriate market-value weights. A much cheaper alternative would be to construct a synthetic FTSE 100 tracker using a combination of cash deposits and FTSE 100 forward contracts. This is achieved by placing, say, £1m on deposit for one year earning the one-year LIBID deposit rate of, say, 5%. At the same time, a one-year FTSE 100 forward contract is purchased at, say, 5500 from an investment bank, when the spot FTSE 100 index is 5400.

Assuming no change in the FTSE 100 index over the course of the year, the situation at the end of the year is:

- The deposit of £1m grows to £1 050 000.
- The forward expires at 5400, a loss of 100 points or £18 519 ((£1m/5400) × 100).
- A net total portfolio value of £1 031 481.

The synthetic FTSE 100 tracker has generated a return of 3.1% (which has come entirely from the cash deposit) and this will broadly compensate for the dividends that the FTSE 100 shares would have paid.

1.7 ALTERNATIVE INVESTMENTS

Alternative investments and *alternative investment strategies* (AIS) are a new class of investments/strategies that took off in the early 1990s. They are divided into three classes, according to the type of investment strategy used:

- *public market strategies*, which use exchange-traded instruments; examples are:
  - directional funds
  - hedge funds (hedge funds is a term that has become synonymous with public market strategies even though it is only one of the possible strategies)
  - arbitrage funds
  - funds of funds

- *private market* or *private equity strategies*, which use instruments that are not traded on official exchanges; examples are:
  - venture capital (venture capital is a term that has become synonymous with private market strategies even though it is only one of the possible strategies)
  - leveraged buyouts (LBOs)
  - distressed debt
- *natural resource strategies*, which involve the purchase and sale of physical, rather than financial, instruments.

The key driving force behind the growth in alternative investments has been the increasing volatility and correlation in global equity and bond markets, the principal traditional asset classes. The objective of alternative investments is to provide higher risk-adjusted returns and enhanced diversification, arising from the alternative assets' low correlation with the traditional assets that are typically held in investors' portfolios. Most of the funds discussed below have returns that have correlation coefficients with equity and bond markets in the range -0.3 to $+0.3$, except for long–short equity funds, which have a correlation with the equity markets of about 0.7. This has been called the quest for *decorrelation*. In principle, therefore, alternative investments are a valuable risk-reducing investment vehicle, since they offer 'structurally decorrelated performance'. In addition, alternative investments have produced some very high returns in the past. In short, the aim of alternative investments is to generate an absolute level of returns that, over time, is independent of the returns on traditional asset classes.

Alternative investments are now recognised as being one of the five main asset management styles:

- passive (index matching);
- active balanced (core);
- active specialist (satellite);
- asset–liability management (ALM);
- absolute return (alternative investments).

The first four of these strategies are discussed in detail in Chapter 7.

1.7.1 Public market strategies

We begin with *public market strategies*. The riskiest of these are *directional funds* (also known as *opportunistic funds* and *systematic trading*

funds). These focus on the direction that markets are moving in and take positions based on manager opinion. The main types of directional fund are as follows (in order of decreasing risk):

- *Global macro*. Global macro managers analyse the impact of global macroeconomic variables on the principal asset classes of equities, bonds, currencies and commodities. The managers can invest in any market in the world. Strategies are usually implemented using derivatives (e.g. futures overlays), since the greater liquidity of these markets means that large positions can be established without moving the market price of the underlying security adversely. Global macro funds are, therefore, taking large directional bets (they are also sometimes known as *momentum investors*), which are also highly levered on account of the use of derivatives, with a degree of leverage of three times the fund's capital base not being uncommon. They tend to have absolute return targets and perform best when there is substantial volatility in interest rates and exchange rates. However, poor recent performance led hedge fund pioneers Julian Robertson and George Soros to close down their Tiger and Quantum global macro funds. The amount invested in these funds is now less than 5% of the total.
- *Systematic trading*. The fund manager takes a directional view of markets based on computer models that incorporate market trends and behavioural psychology.
- *Tactical trading*. The fund manager attempts to identify the principal factors (e.g. interest rates and exchange rates) determining changes in asset prices.
- *Emerging markets*. These tend to be long-only funds with significant exposure in emerging-market equities, bonds and currencies. There are two main reasons for this: a long position is difficult to hedge using emerging-market derivatives because of their poor liquidity, and short selling is generally prohibited in emerging markets. However, some emerging-market hedge funds will use main-market derivatives to at least partially hedge their exposure. Performance is usually measured against a regional market index.
- *Market timing*. These funds use technical trend-following indicators to switch out of investments that appear to be beginning a down-trend and to switch into investments that appear to be beginning an up-trend; usually the switches are between equity mutual funds and money-market funds.

- *Short selling* and *short biased*. These funds become popular during bear markets. Short positions are created by borrowing securities owned by a third party and selling them in the market (placing the received funds on deposit) with the expectation of buying the shares back at a later date, hopefully at a lower price, and returning them to the original owner in return for paying a stock-borrowing fee.
- *Active long or short*. Trend following or counter-trend following using proprietary computer models to analyse different technical factors and generate buy or sell instructions; there is no human interference with the trading decision.
- *Industry sector investing*. These funds invest in the securities of industries that are experiencing explosive growth as a result of technological or regulatory developments.
- *Long or short volatility*. These funds use option combinations to take a view on changes in the volatility of securities. For example, if volatility is expected to increase, options are purchased, while if volatility is expected to fall, options are sold.
- *Equity non-hedged*. These funds are mainly long equities, but have the ability to hedge with short sales and/or stock index options. In bull markets there is a long bias, while in bear markets there is a short bias. Also known as *stock pickers*.
- *Passive long or short*. These funds take the opposite position of commercial hedgers in order to extract an 'insurance premium'.
- *Strategic block investing*. The fund manager identifies undervalued companies, purchases a substantial block of shares in these companies and then uses these holdings to focus the attention of the incumbent management on increasing shareholder value and hence the companies' share prices.
- *Managed futures*. These use futures and options to take a directional view on market movements. They are also known as *commodity trading advisers* (CTAs). Investment horizons tend to be very short term, ranging from a few hours to no more than a couple of weeks. Some use only quantitative techniques and rely on computerised algorithms to generate buy and sell instructions. Others, known as *discretionary traders*, are more judgemental.

The most common of the alternative investments is *hedge funds*. The first hedge fund was established by Alfred Winslow Jones in the US in 1949. He created a fund that was *long* (i.e. had positive holdings) in US shares that he believed would go up in price and *short* in US

shares that he believed were overvalued. The term hedge fund arises from their ability to go short and hence protect their returns from market falls. Most hedge fund managers today were formally traders from the proprietary and derivatives trading desks of the large investment banks, such as Goldman Sachs, Merrill Lynch and UBS. To cap the drain on the investment talent leaving their organisations, a number of investment banks have set up their own hedge funds: HSBC, Henderson, Gartmore, Jupiter, Martin Currie, Merrill Lynch, Alliance Capital, ABN AMRO, CSFB and SocGen. Critical to the success of a hedge fund is the fund manager's skill at identifying undervalued and overvalued securities. This skill is known as *alpha*, and good fund managers will generate positive alphas for their funds.

The main types of hedge fund are as follows (in order of decreasing risk):

- *Long–short equity*. These funds take both long and short positions in equities, hoping to profit on both sides: they are also known as *double alpha* or *market-hedged* or *equity-hedged* funds. Fundamental analysis is used to identify both undervalued and overvalued stocks. However, so-called *unengineered short positions* may need to be created, not because the fund manager believes a stock is overvalued, but only to provide capital for overweight positions. The funds tend to specialise in growth bias, value bias, small cap, large cap, sector (e.g. technology), region (e.g. Europe), long-term investing (e.g. in small-cap value companies) or short-term trading (e.g. in deteriorating growth companies). They perform best in tranquil markets where equity prices are driven by fundamental factors. Most charge a fee based on absolute return, although some charge a fee based on the outperformance of a benchmark index. This is the largest category of hedge funds with 47% of total assets.[6]
- *Event-driven*. These take advantage of pricing inefficiencies arising from corporate events. They are also known as *corporate lifestyle investing*. Examples are:
  - *Merger arbitrage funds*. These take long positions in the target company and short positions in the acquiring company. Also known as *risk arbitrage*. The fund manager's skill lies in the ability to judge the likely success of the takeover; this involves an assessment of shareholder voting intentions, regulatory reaction, the response of

[6] *Investments and Pensions Europe: Hedge Fund Report*, November 2001.

the incumbent management and the possibility of litigation. The takeover premium in the target's share price is likely to vanish rapidly if the merger fails.

  - *Specialist credit*. These raise capital for companies that are finding it difficult to raise capital by other means. The investment vehicle is a convertible bond that is convertible into the company's equity at a discounted conversion price. Also known as *private placement arbitrage*.
  - *Distressed securities funds*. As one example, the fund manager purchases convertible bonds that are trading well below par (as a result of a corporate insolvency or reorganisation combined with the distressed sale of assets) and which can be converted to equity at a later date. The market risk can be hedged by selling stock index futures. As another example, the fund manager purchases the highly collateralised senior debt of those companies in financial difficulties whose bonds have fallen from investment grade to non-investment grade (or junk) status. Institutional investors who are only able to invest in investment-grade securities must sell these bonds immediately and hence the bonds will be trading at a discount. The success of these strategies depends on the ability of the fund manager to estimate correctly the true value of the bonds in the worst-case scenario. In the second case, for example, the companies either recover and the bonds rise in value or the companies fail and the collateral backing the bonds is sold off at a price sufficient, if the fund manager's estimates were accurate, to generate a positive return to the fund.

- *Convertible arbitrage*. This involves the purchase of a convertible bond and the short sale of the underlying equity. The fund receives both the coupon on the bond and the differential between the price of the convertible and the short position. This is a bear market strategy and makes money because the gain from the short position is usually larger than the loss on the convertible. Leverage of 3–5 times the balance sheet is common.
- *Mortgage-backed securities (MBS) arbitrage*. This involves the purchase of a mortgage-backed security with credit quality and prepayment risk and the short sale of a non-prepayable US Treasury bond.
- *Long–short fixed-income*. These funds take both long and short positions in government and corporate bonds using spot, futures and swap transactions.

The term arbitrage has a very strict meaning in finance. It means buying a security in one market and immediately reselling it at a higher price in another market. A pure arbitrage strategy therefore involves no risk or extended position-taking. Given the general efficiency of financial markets, it is hard in reality to find pure arbitrage strategies. In practice, therefore, the term arbitrage has come to mean trading in pairs of related but mispriced securities in a way that involves as little risk as possible. The word arbitrage appeared in the description of some of the hedge funds above, but this is a misuse of the term, since the underlying strategies involved some risk on account of having a directional bias.

The main types of arbitrage fund are as follows (in order of decreasing risk):

- *Basis trading* or *basket trading* or *portfolio trading*. The aim is to buy the underlying basket of stocks comprising an equity-market index and simultaneously sell the futures contract on the index if the basis (the difference between the futures and cash-market prices) exceeds the cost of carry (the cost of borrowing the funds to buy the basket of stocks, net of the dividends received on the stocks during the holding period when the futures contract matures); the difference between the basis and the cost of carry represents the profit on the trade at maturity when the futures contract settles and the stocks are 'delivered' against it. Leverage of 2–3 times the balance sheet is common.
- *Equity options arbitrage*. The aim is to benefit from a perceived mispricing of equity options by combining long positions in overpriced options and short positions in underpriced options to create synthetic payoffs.
- *Equity market-neutral* or *relative-value arbitrage*. The aim is to construct a portfolio with no systematic or market risk, industry bias, market capitalisation bias or geographic bias, but which is exposed to a perceived mispricing between related securities by being long relatively undervalued stocks and short relatively overvalued stocks. Leverage of 2–3 times the balance sheet is common. In theory, market-neutral portfolios have low risk and the return objective is usually to beat the risk-free rate of interest. Nevertheless, market-neutral funds tend to have a larger tracking error relative to their benchmark, in the range 5–10%, compared with traditional funds, which tend to have tracking errors in the range 2–3%. This implies that a market-neutral fund with a tracking error of 10% that was subject to

a two-standard-deviation event (one which occurs with a probability of 5% in a given year) would deviate from its benchmark by either +20% or −20%.

- *Fixed-income or convergence arbitrage*. These exploit pricing anomalies between related fixed-income securities. Examples include: going long a 5-year bond and short a 10-year bond in the same market; going long a 5-year bond in one market and short a 5-year bond in a different market; going long and short different classes of bond of the same issuer (this is known as *capital structure arbitrage*). Again, these strategies should have low risk and the return objective is usually to beat the risk-free rate of interest. However, substantial leverage of 15–20 times the balance sheet is common.

Finally, there are *funds of funds* (FOFs). These invest in other hedge funds, typically between two and thirty, with the aim of benefiting from diversification arising from the low correlated returns of the constituent funds. For example, long–short equity funds are not likely to have returns that are correlated on the downside with convertible bond arbitrage funds. Hence, FOFs, unlike directional funds, do not depend on the market timing ability of the fund manager, an ability which empirical studies demonstrate is lacking for most fund managers (Blake *et al.*, 1999). FOFs can still specialise, say in event-driven funds, or they can choose from all types of hedge fund. They charge fees of 1–3% in addition to the fees charged by the constituent hedge funds themselves. Some funds have a performance-related component, for example, a basic fee of 1% plus a performance-related fee of 15% on gains in excess of 6%. FOFs also perform on-site due diligence when selecting the constituent funds and closely monitor their performance after selection. This is useful for investors, such as small pension funds, with low *governance budgets*; that is, low capacity to manage their investments in terms of time, expertise and organisational structure. However, there is a scarcity of hedge fund selectors and many new FOFs use hedge fund consultants to select the constituent funds. Increasingly, FOFs treat hedge funds as a talent pool rather than an asset class.

1.7.2 Private market or private equity strategies

Private market strategies, more commonly known in the UK as *private equity strategies*, are much more difficult to value than public market strategies, since, by definition, there is no liquid market in the underlying

securities. The invested funds are tied up for a number of years. Such investments are therefore not suitable for investors with short-term liquidity requirements, although there is a market for secondary interests (albeit at a substantial discount to value). However, the benefit from patient investing is high long-term returns.

The *venture capital* (VC) industry began in what became Silicon Valley, south of San Francisco, and around Boston after the Second World War. A group of *venture capital partnerships* was established to invest in start-up and early-stage companies in the (computer and information) technology sector. The partnerships developed strong local networks and a high degree of internal expertise in technology. There was no such similar development of a VC industry in the UK. Subsidiaries of UK banks calling themselves venture capital firms began in the 1970s and 1980s to invest in unquoted companies, but little of this was in VC as defined in the US, mainly because of a dearth of good investment proposals. The VC industry that did develop in the UK financed a different kind of project, namely buy-outs and buy-ins of mature companies, usually the subsidiaries of quoted companies. The investee company took on substantial debt in the belief that it could be serviced from the cash flows into the company and in so doing magnify the value of the equity, hence the term leveraged buyout (LBO). In the US, VC and LBOs are separate categories of private equity, with the funding provided by different types of investor with different backgrounds. Investors tend to invest in one type or the other.

The main types of venture capital fund are:

- *Early-stage funds*. These provide seed capital for product development and initial marketing during the first three years of the life of a company.
- *Development funds*. These invest in funds in an expansion phase that are in need of capital to expand or make acquisitions.
- *Mid-management buy-out/buy-in funds*. These finance buy-outs (MBOs) of existing businesses by the current operating management or provide funds for an external management group to buy into (MBIs) an existing company, both in the range £2–£10m of invested equity.
- *Large management buy-out/buy-in funds*. These finance buy-outs and buy-ins above £10m of invested equity. These funds also finance institutional buy-outs (IBOs), where a private equity firm purchases a company with the aim of giving a stake at a later stage to the incumbent or incoming management, and leveraged build-ups (LBUs), where a

private equity firm buys a company as principal with the aim of making further related acquisitions in order to develop an enlarged business group.

- *Generalist funds*. These invest in all sizes of company at all stages of development in both the UK and globally.
- *Technology*. These specialise in the technology sector.
  Non-technology. These invest in all sectors except technology.

The typical lifecycle of a venture capital fund is ten years from initial investment to final exit, when the fund is wound up, the investments are liquidated and the gains realised. The following exit methods are used: trade sale (most common), flotation on a stock exchange (common), a share repurchase by the company or its management or a refinancing of the business (least common). Secondary purchases of the company by another private equity firm are becoming more common.

With venture capital, the biggest risk is choosing a poor fund manager, since it takes far longer than with other investments to ascertain whether the fund manager is selecting good investments or not. This is partly because of reliance on interim valuations, which can be largely subjective. The other two factors influencing returns are the valuation at acquisition and the strength of the underlying economy. In terms of valuations, price–earnings multiples have increased for large transactions where competition amongst fund providers has increased, but they are falling for small-scale transactions where competition is less aggressive.

There are a range of vehicles for investing in venture capital and private equity:

- *Venture and development capital investment trusts* (VDCITs) have the advantage of daily measurement of performance and high liquidity, and they are able to leverage up by borrowing; one of the largest funds is Schroders Ventures International Investment Trust (SVIIT).
- *Funds of funds* (FOFs) have included funds determined by a gatekeeper based on his research and knowledge of management expertise and historic performance, but there are two layers of fees, and valuations are made no more frequently than quarterly due to difficulties valuing unquoted companies prior to sale or flotation; high minimum investment of £5m.
- *Limited partnership venture capital funds* have between 10 and 30 limited partners with 10-year investment horizons, a high level of

control and accountability. They use general partners with up-to-date knowledge of venture capital fund managers to structure portfolios; general partners receive a performance fee called *carried interest* or *carry* if the performance of the fund exceeds a hurdle rate. Valuations are no more frequently than quarterly due to difficulties valuing unquoted companies prior to sale or flotation. This is the most popular investment vehicle.

- *Dedicated venture capital* or *private equity funds* are managed directly on behalf of the investor (typically an institutional investor such as a pension fund or insurance company), so there is a high level of control and accountability, but they require substantial funds to be commercially viable and to obtain good diversification.
- *Direct investment in unquoted companies*. This gives full control with direct access to companies, but requires substantial funds to be commercially viable and to obtain good diversification, a high level of staff expertise, considerable commitment and a good flow of investment opportunities (only 1% of proposals are accepted).

Another issue is *draw downs*. These are payments to the partnership by investors in order to finance investments. Funds are usually drawn down from investors on a deal-by-deal basis and investors have to budget for these calls, the timing of which is hard to predict.

Most venture capital funds are members of the British Venture Capital Association and have their performance measured by PricewaterhouseCoopers and published annually in the *BVCA Private Equity and Venture Capital Performance Measurement Surveys*. An example of a venture capital management group is CIN Venture Managers, or CINVEN, which operates the venture capital operations of the former British Coal Pension Fund and the British Rail Pension Fund. CINVEN was set up by the British Coal Pension Fund in 1976 and the pension fund has around 3% of its assets in venture capital investments. CINVEN is the second-largest venture capital management group after 3i.

1.7.3 Natural resources

These are specialist strategies with higher transaction costs than the above strategies.

Natural resource strategies involve the purchase and sale of physical, rather than financial, instruments; examples are:

- commodities;
- energy;
- timber.

Property (this is a US classification, since, in the UK, property is regarded as a mainstream asset class); examples are:

- private real estate, including farmland;
- real estate investment trusts (REITs).

1.8 SOCIALLY RESPONSIBLE INVESTMENT

In recent years, *social, environmental and ethical* (SEE) matters have had an increasing role in influencing pension fund investment decisions under the label of *socially responsible investment* (SRI). The 1995 Pensions Act requires pension funds to consider SRI matters and from July 2000 to disclose in their statements of investment principles whether they have an SRI policy, but it does not require them to adopt an SRI policy.

The Association of British Insurers (ABI) has published guidelines on how company annual reports should comply with SEE matters. The guidelines cover five areas of corporate activity: employment, the environment, human rights, communities and business relationships. Investors should expect to find answers to the following questions:

- Has the company made any reference to SEE matters? If so, does the board take these into account regularly?
- Has the company identified and assessed significant risks and opportunities affecting its short- and long-term value arising from its handling of SEE matters?
- Does the company state that it has adequate information for identification and assessment?
- Are systems in place to manage the SEE risks?
- Are the remuneration incentives relating to the handling of SEE risks included in risk-manangement systems?
- Does directors' training include SEE matters?
- Does the company disclose significant short- and long-term risks and opportunities arising from SEE matters? If so, how many different risks/opportunities are identified?

- Are policies for managing risks to the company's value described?
- Are procedures for managing risk described? If not, are reasons for non-disclosure given?
- Does the company report on the extent of its compliance with its policies and procedures?
- Are verification procedures described?

SRI investments can be made on the basis of recommendations from organisations such as the Ethical Investment Research and Information Service (EIRIS) or the Investor Responsibility Research Center (IRRC). EIRIS, for example, has a list of SRI companies, all of which are included in the FT-Actuaries All Share Index. The list contains mainly small companies and excludes companies with interests in tobacco and brewing. It also excludes the finance sector, such as banks and insurance companies. Funds based on the EIRIS list have in the past outperformed the FT-Actuaries All Share Index, so SRI does not necessarily imply low returns. There is also a FTSE4Good index of fifty qualifying FTSE 100 companies: it outperformed the FT-Actuaries All Share Index during its first year of existence beginning in October 2000.

The following fund managers run SRI funds for pension funds: Friends, Ivory & Sime (Stewardship Pension Fund, Institutional Ethical Exempt Fund and Balanced SRI Managed Pension Fund), Henderson Global Investors (Global Care Growth OEIC, Global Care Income OEIC and Global Care Asia–Pacific Fund), Jupiter Asset Management (Jupiter Ecology Fund, Jupiter Environmental Opportunities Fund and Jupiter Global Green Investment Trust), Morley Fund Management (Norwich Sustainable Future Managed Fund), Scottish Widows Investment Partnership (Scottish Widows Environment Fund and Abbey Ethical Trust) and Standard Life (Pension Ethical Fund).

1.9 GLOBAL CUSTODY

Pension funds use *global custodians* to hold the assets that they purchase. The services provided by global custodians are listed in Table 1.3.

In the past, pension funds used the custodial services provided by their fund managers, which, in a multi-manager pension fund, meant using multiple custodians using different reporting formats. During the 1990s, pension funds began to switch to a single custodian independent of these fund managers. By 2000, even fund managers were beginning to outsource their back office to custodians, since, by using the

Table 1.3 Global custody services

Service	Components	Fee type
Safe-keeping	Physical custody Registration of securities Cash forecasting	Basis points
Transactions	Settlement of trades Dividends, interest and tax reclaim Investment record-keeping (using a master record-keeping (MRK) service) Corporate actions Clean payments	£ per trade
Reports	Statutory reporting on the asset holdings on a worldwide basis (web reporting, electronic download and paper format) Accounting Taxation Custodian performance Market updates to alert trustees about regulatory changes in different markets	£ per portfolio p.a.
Corporate governance	Voting services, proxies	£ per portfolio p.a.
Value added	Performance measurement and attribution Compliance reporting Unit trust administration	£ per portfolio p.a.
Revenue added	Securities lending Foreign exchange Cash management	Mixed

Source: *Pensions Week*, 17 July 1998.

custodian's systems, a fund manager can access all the data, analyse it via a web-enabled browser application and download it into reports instantaneously.

The main global custodians are large banks, such as Northern Trust and State Street. The banks have overseas offices, which act as *sub-custodians* for pension funds' international asset holdings, thereby helping to preserve credit quality in foreign marketplaces. Standard client agreements cover negligence, fraud, wilful default and insolvency protection; the main exclusions are national intervention, acts of war, terrorism, revolution, strikes, nuclear fusion and acts of God. Pension

funds with assets of £500m or more can get global custodial services for just 0.005% (half-a-basis point).

An example of the benefits of using a global custodian is the ability to monitor the efficiency of the foreign exchange transactions conducted by the fund manager against the quoted mid-market rates for the relevant currency pairs. Another example is securities lending, whereby the pension fund assets held by the global custodian are lent to other investors (say to facilitate a short sale transaction) in return for a securities lending fee, which enhances the return to the pension fund. Recent added services include voting services in response to increased awareness and involvement by pension funds in corporate governance and compliance monitoring.

1.10 DIFFERENT ASSET CHARACTERISTICS AND USES

Pension funds hold some or all of these types of assets in their portfolios. The different assets have different characteristics and different uses. In this section we examine some of these characteristics and uses.

1.10.1 Asset characteristics

The first characteristic is the *degree of liquidity*. This depends on both the marketability of a security and the transaction costs involved in the liquidation; it also depends on the relative volume of a security coming to the market at any single time. Cash and money-market securities are the most liquid of assets and property the least; between lie, in order of decreasing liquidity, gilts, ordinary shares, options, futures, debentures, loan stock, preference shares, loans and mortgages.

The second characteristic is the *degree of capital-value certainty* (also called *price risk*). Some assets, such as money-market securities, loans and mortgages, have a high degree of capital-value certainty in nominal terms. Others, such as fixed-income bonds and index-linked bonds, have capital-value certainty only at maturity – the former in nominal terms, the latter in real terms. Before maturity their capital values move inversely with nominal and real interest rates respectively (see Equations (1.5) and (1.6) and also Appendix C of the book). Other assets, shares, options and property, for example, exhibit price risk and so have no capital-value certainty at any stage.

The *degree of income certainty* is the third important characteristic of assets. Money-market securities and fixed-term fixed-income bonds and preference shares have complete, or at least a high degree of, income

certainty, while fixed-rate loans and mortgages only exhibit complete income certainty if there is no early repayment. In contrast, the dividend payments on shares are not guaranteed, and derivative securities such as futures and options make no income payments at all.

The next characteristic is *inflation risk*. Only index-linked bonds offer a complete hedge against inflation. Securities such as ordinary shares, property and commodities tend to be good inflation hedges over the long term, although this is not guaranteed. Fixed-income bonds, loans, mortgages, cash and money-market securities are poor inflation hedges, since they all lose value as the price level increases. In between lie variable-rate securities, such as floating-rate notes: if interest rates increase with inflation, the income on variable-rate securities increases to compensate for falling real capital values.

The fifth characteristic is *default risk*. Only government-guaranteed stocks and direct holdings of property are entirely free of default risk. All private-sector securities have some risk of default, unless they are backed by effective collateral. For example, mortgages are fairly safe, since they are backed by property (that is, they are *asset-backed*).

The sixth characteristic is *currency* (or *exchange-rate*) *risk*. This is the risk that affects all securities held in foreign currencies: fluctuating currency values will lead to fluctuating capital values for all overseas securities when measured in sterling.

The final characteristic is *correlation* with the returns on other assets. If an asset, such as alternative investments, has a low correlation with the returns on other assets, it is useful for diversification purposes, since it helps to reduce the volatility of the returns on the overall portfolio.

1.10.2 Asset uses

Having discussed the various characteristics that assets possess, we can consider how pension funds use assets in their portfolios. Most assets are used as part of sophisticated portfolio-management strategies, the most important of which are discussed in Chapter 7. The portfolio composition of pension funds differs depending on whether the markets are volatile or stable, and on whether the funds themselves are mature or immature.

Take, for example, money-market securities. Pension funds are, in general, very long-term investors, but they will hold short-term securities for one of two reasons. First, pension funds receive periodic cash-flow payments. These can be dividend payments on their share-holdings, coupon payments on their bond-holdings, rent on their

property-holdings, as well as contribution payments from both employees and the sponsoring firm. Such receipts, although fairly predictable, will often be irregular and generally will be in small amounts. It will often be inconvenient to reinvest these payments in the capital markets the moment that they are received. Instead, they will be invested in safe but high-yielding money-market securities until a sufficient amount has been accumulated to invest in longer-term assets. Their first use will be to fund pensions in payment, however.

Secondly, money-market securities are held for the purpose of *market timing* (or tactical asset allocation). In periods when the capital markets are depressed, such as during the share-market crashes of 1974–5, October 1987 and 2000–03, pension funds will build up fairly large holdings of liquid assets for strategic reasons. This will be done either by reducing directly their holdings in shares, bonds and so on, or by refraining from investing cash inflows in such instruments. In either case, liquid-asset holdings are built up in readiness for investing in the capital markets when the bear market bottoms out and a new bull market starts.

In stable markets, immature pension funds will want to go for long-term real growth; that is, they will want to generate a real return on their investments after allowing for inflation. They will also want to maintain a fair degree of liquidity. This will be achieved by having a portfolio dominated by equity. Shares suffer from both volatility and default risks, but these can be reduced through *diversification*; that is, by holding a widely spread portfolio of shares, both domestically and overseas. Overseas assets will still suffer currency risk, but this risk can be *managed* or *hedged* using *exchange-rate futures*, *forwards* or *options*. Shares also suffer from capital-value uncertainty or price risk; this risk can be hedged using *stock-index futures* and *options*. In addition, over the long term, ordinary shares tend to provide good inflation hedges. The price risk associated with bond-holdings is the risk of increases in interest rates, sometimes called *interest-rate risk*; this risk can be hedged with *bond futures* and *options*. Pension funds can also write options to generate premium income: for example, during bull markets pension funds can write put options, while during bear markets they can write call options, since in neither case are the options likely to be exercised.

Real assets differ substantially from financial assets in a number of important respects. Direct holdings of real assets tend to be better long-run hedges against inflation than financial assets, even compared with those financial assets such as equity that represent indirect claims against real assets. But against this, the markets for real assets are less liquid

than those of financial assets. It is simply not possible to issue new Old Masters; land can be reclaimed, but this takes time; and buildings can be rebuilt, but this also takes time as well as requiring planning permission. Similarly, real assets cannot be bought and sold in secondary markets as cheaply or as quickly as can financial assets. Related to this, real assets are not such close substitutes for each other as are financial assets. All this again tends to make real assets suitable only as long-term investments, rather than short-term, speculative investments. Indeed, in the short term, real assets can experience substantial falls in value (both nominal and real), and this risk is difficult both to predict and to hedge against.

As pension funds mature, a different investment strategy is required. Income certainty and capital certainty become more important investment objectives than real capital growth. When pension funds are immature, their long-term liabilities can be met with an asset structure dominated by equity. However, as pension funds mature, the liabilities become increasingly short-term. Pension payouts have to be paid according to a definite schedule, and short-term equity values are too volatile to guarantee meeting this payment schedule. Instead, the asset allocation has to be moved away from equity towards fixed-income and indexed bonds as pension funds mature, since the cash flows on these instruments are more reliable than those on shares. This will also have the effect of reducing the likelihood of an actuary's valuation of the pension fund's assets and liabilities revealing an actuarial deficit, with its consequences for increased contribution rates. Interest-rate and inflation swaps can be used to fill gaps in the underlying bond portfolio, as the section on liability-driven investment in Chapter 7 shows.

Related to income certainty is capital-value certainty. Pension funds must ensure that the value of their assets equals the actuarial value of their liabilities. The volatility of equity prices makes this objective much more difficult to achieve with mature funds; even if the equity-price risk can be hedged, this cannot be done without some cost. However, fixed-income bonds can be used to achieve at lower cost the desired objective with respect to capital-value certainty. This is because the volatility of bond prices is much less than that of equity prices, since bond-price movements are tied down by their known value on the maturity date. Before maturity, the bond's capital value can be hedged using *interest-rate futures, options* or *swaps*.

Swaps have a number of uses. One of the most important is as a hedging instrument. For example, a pension fund holding fixed-coupon bonds that expected interest rates to rise could execute an *asset swap*

and earn a return related to LIBOR. Of course, given the capital loss that would be expected on the bonds, it might still be better for the pension fund to sell the bonds rather than undertake the swap. Another use of swaps is as an instrument for asset and liability management. On the liability side, swaps (e.g. inflation and interest-rate swaps) can be used to reduce funding costs, while on the asset side they can be used to increase returns. This last factor is of particular value to pension funds.

It is important to examine the risks involved in executing swaps. There are two main types of risk facing the swap counterparties: *credit risk* and *position* or *market risk*. Credit risk is the risk that the other counterparty defaults on his obligations. Position or market risk is the risk that market interest rates or exchange rates diverge from the rates agreed in the swap, leading to a position loss for one counterparty. While credit as such is not extended when a swap is executed, there is a risk that the promised payments and receipts under the swap are not, in fact, made. The present value of these future payments and receipts (discounted at the spot or swap interest rate[7]) represents the extent of exposure. Credit risk declines as the swap reaches maturity. Position or market risk, however, varies over the life of the swap according to the extent of movements in interest or exchange rates. The two types of risk are not unrelated. For example, a swap might be showing a position gain but the other party then defaults.

The use of derivative instruments such as futures, forwards and options by UK pension-fund managers has increased substantially since the passing of the 1990 Finance Act, which exempted them from tax on their trading income from futures, forwards and options. As a result of this change in the tax regime, turnover on the FTSE 100 stock-index futures contract on the London International Financial Futures and Options Exchange (LIFFE) increased by 40% during 1990.

Stock-index futures are the most frequently used of the derivative products. Futures involve considerably lower transaction costs than options and, for institutional investors, stock-index futures involve lower transaction costs than trades involving the underlying stocks. The most important use made of stock-index futures by active pension-fund managers is to make rapid tactical changes to asset allocation through *pre-positioning*. In other words, increased or reduced exposure in any particular market is achieved through the purchase or sale of stock-index futures, which locks in, respectively, the purchase or sale price

[7] Spot and swap rates are explained in more detail in Appendix B of the book.

of securities prior to buying or selling them in that market. Stock-index futures can also be used to undertake *overlay strategies*, that is, temporary adjustments in exposure without any subsequent transactions in the underlying cash portfolio. Another important use of stock-index futures is as a temporary repository of surplus cash, thereby ensuring that funds are always invested and so avoiding the risk of missing an upturn.

Forward-currency contracts are the second most frequently used of the derivative products (the size and efficiency of the forward-currency market in London destroyed its currency futures market). Forward-currency contracts are used mainly to hedge short-term exposures in foreign bond markets. They are not used to hedge long-term exposures in equity markets; indeed, currency exposure is often regarded by investors as one of the main benefits of international diversification.

While the use of derivatives is increasing amongst UK pension-fund managers, it is nevertheless still not as widespread as in the USA. The main reason for this is the reluctance of trustees to use a product that can involve unlimited losses or might involve being 'fleeced by unscrupulous floor traders' (as was proved by the Federal Bureau of Investigation in the case of the Chicago futures markets in the late 1980s). Another reason is the cost of operating computer systems that deal with the administration (clearing, settlement, marking to market, and so on), monitoring and performance of options and futures positions. Finally, there are problems in understanding the complexities of derivative products (especially options), as well as doubts about the operational effectiveness of derivative markets when they are needed most: the failure of equity futures markets during the October 1987 crash led to substantial disillusionment in the fund management profession.

The first comprehensive study of the benefits to institutional investors from using alternative investments as part of their overall portfolios was made by Schneeweis *et al*. (2000). The key findings of this study are:

- Under past (e.g. historical) market environments, a portfolio of hedge funds and managed futures offers improved risk and return opportunities when considered as an addition to both a traditional equity portfolio and a mixed portfolio (including equity, bonds and property).
- Under forecasted return relationships consistent with general market conditions, a portfolio of hedge funds and managed futures offers improved risk and return opportunities when considered as an additions to both traditional equity and mixed portfolios.

- Under alternative market conditions (e.g. extreme low/high returns of the equity and bond portfolio), the benefits of a portfolio of hedge funds and managed futures have a greater impact on risk reduction and return enhancement. More importantly, the portfolio of hedge funds and managed futures offers managed portfolio returns not obtainable through other traditional equity, bond and property investments.
- The benefits of a portfolio of hedge funds and managed futures are not sensitive to the globalisation of the equity and bond portfolio. The high correlation between international equity markets as well as the high correlation between international bond markets, especially in periods of extreme market movements, makes the results (improved risk and return opportunities) for the inclusion of a portfolio of hedge funds and managed futures consistent across a wide variety of traditional asset portfolio holdings. However, the degree of benefit will depend on the prevailing market environment and the degree to which that market environment is anticipated.

These findings have been confirmed by Jaeger (2001). He concludes:

- AIS have come a long way to satisfy the needs of institutional investors. From transparency to liquidity, strategy diversification to risk management, the industry has advanced to such a stage that it nears recognition as its own asset class. The broad range of strategies and sectors in AIS investing demonstrate very attractive risk–reward characteristics. Negative, zero and low correlations to traditional assets and to each other offer attractive capacities for diversification within the investor's global portfolio. For periods when traditional markets suffer, some AIS, in particular managed futures, display consistently positive returns. All the benefits of AIS work to improve dramatically the efficient frontier of the traditional portfolio, producing significantly higher returns with substantially lower risk.
- It is interesting to look at how AIS investors fared during times of market turmoil. Although quite diverse in their returns, hedge funds and managed futures generally showed much better performance than traditional investments during these periods. Interestingly, in difficult market environments, funds of funds have shown much worse returns than the average strategy sector (even after accounting for the extra fee level). I believe this performance pattern mirrors the fact that AIS allocators tend to behave in a pro-cyclical way and overweight the best-performing strategy sectors of the recent past. With too much money flowing into these strategies they are often the first with problems in

the next period of market turmoil. Secondly, futures strategies generally performed well during these critical periods. This justifies their presence as a 'hedge' in any multi-manager portfolio.

- As a final note, the increasing demand for AIS products from institutional investors and the generally higher level of investor sophistication render the 'black box' approach (i.e. investing in nontransparent and illiquid funds) unsuitable. A focus on increased liquidity, transparency and risk management will enable the industry to continue growing as rapidly as in recent years. The increased interest on the part of institutional investors has led to recognition that particular risks are being addressed systematically and to better awareness of the benefits of AIS in the institutional portfolio.

Alternative investment funds have some key differences compared with traditional investments:

- Lower liquidity – entry and exit are monthly or quarterly, rather than instantaneous.
- Capacity constraints – these can be reached more rapidly with some strategies than with others; strategies involving active trading have to work with less capital to avoid the risk of moving prices against the position; strategies involving substantial short positions also rapidly hit capacity constraints, unless short futures positions are used instead, since short positions have to be traded more actively, replaced more frequently and diversified more completely.
- They can engage in substantial leverage – this can increase risk and lead to substantial losses if an event (e.g. Russia's bond defaults in 1998) obliges managers to unwind positions rapidly, thereby causing spreads to widen and margin calls on futures positions to be made, which, in turn, trigger forced sales, leading to losses spiralling.
- Generally poorer price information – there is a range of providers and indices to track performance, but there is no pre-eminent provider of information and no single index has widespread acceptance in the industry.
- Misleading performance data – sometimes based not on actual performance but on reporting simulated past performance from back-testing a notional portfolio.
- Higher performance-related fees – based on a percentage of profits in the range 15–20% (plus a flat fee of 2% of assets under management).
- Offshore domicile – in less-regulated centres, such as the Virgin Islands or the Bahamas, although the managers are generally onshore,

for example in Dublin, and are subject to an established regulatory authority; Ireland permitted hedge funds to be authorised and listed in December 1999.
- Lower transparency – only limited information given on positions held.
- Restricted entry – sometimes by invitation only in order to control the growth of funds and maintain maximum flexibility in investment decision-making.
- High minimum investment.
- Relatively short lifecycles – in the range 5–10 years, so there is a danger of buying into a fund at its peak performance.

To overcome these problems, many investors invest via reputable specialist advisers, who generally recommend funds of funds in order to create a diversified structure.

There are two main types of risk with alternative investments: manager-specific risks and portfolio-specific risks. The principal manager-specific risks are:

- Style drift – the fund deviates from the stated aims.
- Excessive leverage.
- Ineffective risk management or failure to maintain market neutrality, especially in volatile markets; for example, a long–short equity fund with both a small-cap bias and a long bias (on account of the greater difficulty of shorting small-cap stocks with little free float) is susceptible to a flight to blue-chip quality in the event of a severe market stress, as happened in autumn 1998, and hence to losses on both long and short exposures.
- Poor alpha portability – a *star* fund manager skilled in one speciality is transferred unsuccessfully to manage another part of the fund.
- Poor predictability of events – for example, a stock initially believed to be overvalued is shorted and its price falls steadily, showing a profit to the position, but another investor, believing the stock to be oversold, makes a takeover bid for the whole company, causing a sharp upward movement in the stock price before the fund's short position is closed, leading to a net loss on the position.
- Poor managerial control of the fund's traders.
- Unreliable back office.
- Uncontrolled growth in assets, resulting in the fund hitting liquidity constraints.

The principal portfolio-specific risks are:

- inadequate diversification, including regional diversification;
- poor sector selection;
- hidden macro biases;
- an increase in downside correlation in a crisis (sometimes called skew risk).

Although institutional investors have been attracted to alternative investments by the promise of diversification and the very different risk–return profiles from traditional investments, they have been discouraged by the perceived risks and, in some European countries, by regulations.

To get around these problems, capital guarantees (e.g. in the form of unsubordinated structured notes from highly rated issuers) have begun to be offered with a number of public market strategies, especially hedge funds. These eliminate the risk by offering investors 100% capital protection, while enabling them to benefit from most of the upside potential. They also address regulatory concerns for investor protection. In addition, the structured notes are treated as an interest-rate security for tax, accounting and administration purposes. The annual fee for the guarantee is 1–2%. It is also possible to have greater upside participation if the investor is prepared to accept less than 100% capital protection.

Capital-guaranteed hedge funds have the same defensive features as bonds, but have the potential for higher returns. As a result, the market for these products is growing rapidly.

The most common guarantee is the *dynamic hedge* (also known as *portfolio insurance*), since this is the easiest structure for the guarantor to hedge. The guarantor monitors a *reference zero-coupon* (i.e. spot or swap) *yield curve*, which indicates the amount of capital that would have to be invested in zero-coupon bonds at each point during the holding period in order to guarantee a 100% payout at maturity. If the net asset value (NAV) of the hedge fund exceeds the amount of capital implied by the reference curve, then 100% of the investor's funds will be invested in the hedge fund. If the NAV of the hedge fund falls below the reference curve capital requirement, the guarantor will switch part of the hedge fund into zero-coupon bonds. In the extreme case, if the fall in the NAV of the hedge fund is sufficiently great, there might have to be 100% switch into zero-coupon bonds. This locks in a risk-free return for the remainder of the holding period, since it is no longer possible to switch

back into the hedge fund and ensure that the guarantee can be honoured. A highly volatile hedge fund might have as much as 80% invested in zero-coupon bonds.

Other methods for securing guarantees include:

- Zero-coupon bonds with embedded call options. The capital guarantee is provided through a zero-coupon bond, while the call options provide exposure to the hedge fund.
- Total return swap. Again, the capital guarantee is provided through a zero-coupon bond; the exposure to the hedge fund comes from the total return swap with a bank (which charges a spread).
- Insurance. In this case, the capital guarantee is provided through the purchase of an insurance policy from an insurance company.

Finally, it should be noted that the existence of profitable alternative investment strategies (particularly of the market-neutral kind) is a sign of market inefficiency. The high profits should attract new entrants and the resulting competition should drive down returns: in a truly efficient market, market-neutral strategies should generate the riskless return. There appears to be some sign that this is indeed happening.

1.11 CONCLUSIONS

Pension funds invest in financial assets (principally money-market securities, bonds and loans, shares and collective investment vehicles), real assets, derivatives and alternative investments. A substantial part of the remainder of this book will be devoted to examining precisely how they do this. But before doing so, we will examine the role of pensions and pension funds in personal and corporate finance decision-making.

QUESTIONS

1. What are the main types of money-market securities?
2. How is the yield on a Treasury bill determined?
3. List the main classes of bond.
4. Explain the importance of bond credit ratings.
5. What is the difference between a bond and a loan?
6. Derive the formula for the present value of an annuity making semi-annual payments (i.e., the first term on the last line of Equation (1.5)).
7. List the main types of shares.
8. Explain the dividend discount model of share valuation.

9. Explain the difference between unit trusts and investment trusts.
10. How do split-level investment trusts work?
11. What is an insurance bond?
12. How do guaranteed growth funds work?
13. What are the most important factors to take into account when investing in property?
14. What are collectibles?
15. What are derivatives?
16. What is the difference between forwards and futures?
17. Explain the difference between the discounted cash-flow and arbitrage-free models of valuing securities.
18. Explain how futures are priced using the cost-of-carry model.
19. What are options, warrants and convertibles?
20. Explain the difference between put and call options.
21. Explain the difference between the intrinsic value and the time value of an option.
22. Explain the role of a riskless hedge portfolio in the binomial model of option valuation.
23. Explain interest-rate swaps, currency swaps and asset swaps.
24. What are forward-rate agreements?
25. What are the main types of alternative investment strategies?
26. What are the key public market strategies?
27. What are the key types of arbitrage fund?
28. What are the key types of private equity strategy?
29. What is meant by socially responsible investment?
30. What do global custodians do?
31. What are the main asset characteristics that pension funds will consider when selecting their investment portfolios?
32. How do pension funds 'use' assets in their portfolios? How does this depend on the degree of maturity of the pension fund?

APPENDIX: STANDARD DEVIATION, VALUE-AT-RISK AND CORRELATION

Standard deviation is a commonly used measure of the volatility, or risk, of a variable. It measures the extent to which the dispersion of a random variable (such as the return on a security) is concentrated around its mean or average value: if the degree of concentration is high, so that realised values of the variable are always close to the mean, then the standard deviation will be low, and vice versa.

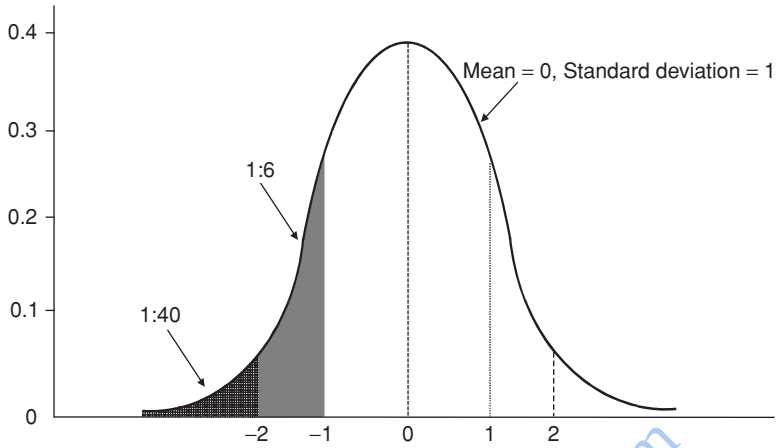

Figure 1.4 The 1-in-6 and 1-in-40 values-at-risk with the standard normal distribution

The formula for calculating the standard deviation of N values of a random variable x_i is as follows:

$$\text{Standard deviation} = \frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N - 1}$$

where

$$\begin{aligned} x_i &= \text{the } i\text{th value (out of a total of } N\text{) of the variable} \\ \bar{x} &= \frac{\sum_{i=1}^{N} x_i}{N} = \text{the mean or average of the set of } N \text{ variables} \\ \textstyle\sum_{i=1}^{N} &= \text{sum over a set of variables from 1 to } N. \end{aligned}$$

Standard deviation is best illustrated in terms of the 1-in-6 and 1-in-40 rules, as shown in Figure 1.4. The figure shows the familiar bell-shaped curve of the standard normal distribution, which has a mean of 0 and a standard deviation of 1.

Suppose that a time-varying random variable is generated by this distribution with annual realisations of the variable. There is then a 1-in-6 chance that the realised value of this variable in a particular year will be less than one standard deviation below the mean. In other words, the area beneath the curve to the left of –1 in the figure is 1/6 of the

total area under the curve. The figure –1 is also sometimes known as the 1-in-6 *value-at-risk*. Another way of expressing this is that in one year in six, we expect to see values less than one standard deviation below the mean. Similarly, there is a 1-in-40 chance that the value of the variable in a particular year (or in one year out of every 40) will be less than two standard deviations below the mean, i.e. less than –2 in Figure 1.4 (this figure is also sometimes known as the 1-in-40 value-at-risk).

Correlation measures the degree to which two variables move together. The degree of correlation lies between -1 and $+1$. If two variables are perfectly positively correlated (with a correlation coefficient of $+1$), they will move exactly in line with each other: for every one unit rise in one of the variables, there will be precisely a one-unit rise in the other variable. If two variables are perfectly negatively correlated (with a correlation coefficient of -1), they will move in exactly opposite directions: for every one-unit rise in one of the variables, there will be precisely a one-unit fall in the other variable. If two variables have a correlation coefficient of zero, they are said to be uncorrelated: the movement of one variable is unrelated to the movement in the other variable. Correlation coefficients lying between 0 and 1 indicate positive, but less than perfect, correlation between pairs of variables – the weaker the positive correlation the closer the coefficient will be to 0 and vice versa. A similar result holds for negative correlation coefficients lying between 0 and -1.

The formula for calculating the correlation between N pairs of random values of variables x_i and y_i is as follows:

$$\text{Correlation coefficient} = \frac{\sum_{i=1}^{N}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{N}(x_i - \bar{x})^2 \sum_{i=1}^{N}(y_i - \bar{y})^2}}$$

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