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Derivatives in their Golden Days (1994 to 2007)

The years between 1994 and 2007 have seen a period of low inflation and low interest rates in most developed economies. With the exception of Japan, these years have also seen staggering rises in the prices of stocks and real estate. The periodic crises (e.g. the Asian crisis which began around July 1997, the bursting of the dotcom bubble in March 2000, or the terrorist attacks on 11 September 2001) have not significantly altered the financial landscape for the worst, at least when compared with the stagnation of the late 1960s, the periodic recessions throughout the 1970s and early 1980s, coupled with sky-high inflation in the late 1970s. The current economic climate since the burst of the sub-prime bubble in August 2007 might herald a less benign era, but that is still something unfolding at the time of writing. Nevertheless, we must approach the explosive growth of derivatives in the light of what could be considered the last two golden decades.

Derivatives are simply products whose payoffs depend on the values of other underlying market variables. For example, an agreement to buy a stock 1 year from now at a pre-agreed price is a derivative since its value depends on the value of the underlying stock.

Since the publication of the Black–Scholes model in 1973, a new framework for understanding derivatives and managing risk has taken shape. Derivatives have existed for a long time (e.g. rice futures in Japan in the 1700s) and have been used to transfer risk. The concept of the traditional insurance, which has also been around for some time, is really also based on risk transfer. However, with an improved framework for pricing and managing risk post-1973, substantial innovations in derivatives occurred as more players entered the field. The advances in technology which allowed for high-powered computing of the prices of derivatives also contributed significantly to their growth on an industrial scale.

Ultimately, however, the economic environment contributed heavily to the demand for derivatives from the investing public. In particular, in a low interest rates environment, can one be blamed for seeking higher yields through other means? And if, as policy-makers would have you believe, the boom–bust cycle has been tamed and we are now in a period of steady growth, is it not appropriate to leverage up with derivatives in our pursuit of yield? Further, corporates with hedging needs have certainly welcomed customised solutions that deal with projected cashflows.

In the following sections, we shall be visiting various products and concepts. Please do not be too bothered if you cannot follow all the products and features mentioned. They are meant more to show the myriad of innovations in derivatives stemming from the environment of the last decade or so. And the concepts will be fully discussed in the remainder of the book. Please note that there is a glossary at the end of the text in case you need to remind yourself of the definition of a new term.

1.1 USES OF DERIVATIVES

Put simply, there are two main purposes of derivatives

(1) hedging
(2) speculation

Hedging

Hedging is where an individual or firm takes a position, with the aim of protecting against an adverse movement in the market environment. As a simple example, suppose you are a US dollar investor and need to pay €100 for some item 1 year from now. It is unclear what spot EUR/USD would be worth 1 year from today. Figure 1.1 shows that as spot EUR/USD (1 year from today) varies between 0.5 and 2, the dollar cost of the €100 payment varies between $50 and $200.

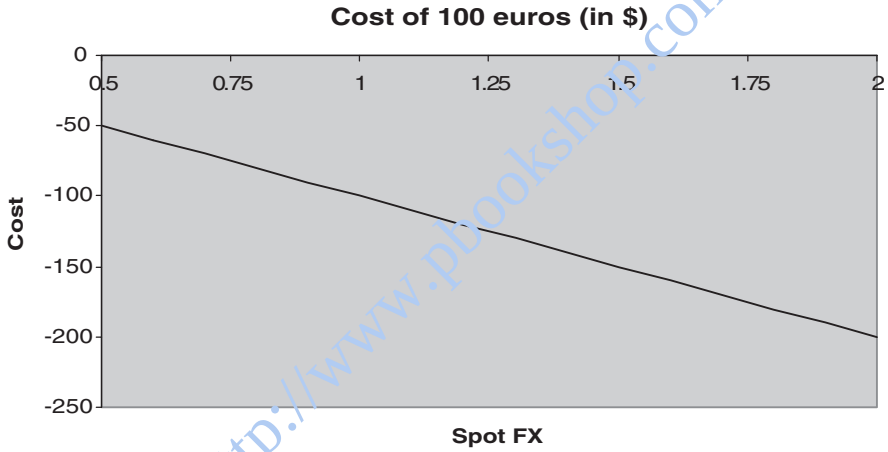

Figure 1.1 As the EUR/USD spot FX rate (1 year from today) varies from 0.5 to 2, the dollar cost of a €100 position varies from $50 to $200.

(Note that the usual style of FX quotation in ccy1/ccy2 is number of units of currency 2 per unit of currency 1. So, EUR/USD refers to number of dollars per euro. The "/" symbol can be misleading for one with mathematical training, as it wrongly suggests itself as the number of euros per dollar.)

You might want to **lock in the rate of exchange by entering a 1-year forward,** agreeing to buy EUR/USD at 1.3 (i.e. to pay $130 for €100), rather than wait until 1 year from now and be at the mercy of the exchange rate at that time. Figure 1.2 shows that as EUR/USD varies from 0.5 to 2, the forward contract has payoff varying from $80 to $70. Notice that you incur a loss on the forward contract itself if EUR/USD 1 year from now is less than $130. However, the forward contract offsets the dollar cost of buying euros, so that the net cost is always $130 (see Figure 1.3).

Suppose, instead, you are not sure you would need to enter the transaction and just want the right (but not obligation) to buy €100 for $130 at the end of 1 year. This is a **call option**. Figure 1.2 shows that the call option and the forward have the same payoff if EUR/USD is above 1.3, but otherwise the payoff of the call option is 0. Since you could walk away if EUR/USD is less

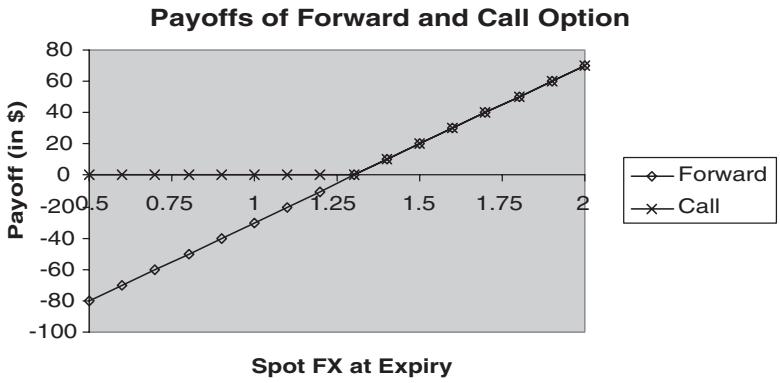

Figure 1.2 Dollar payoffs of a forward and a call option on EUR/USD based on different realised values of EUR/USD. Both the forward and the call option have increasing payoffs as EUR/USD increases but the payoff of the option does not go below zero when EUR/USD falls below 1.3.

than 1.3, the call option must cost something up front. This cost is referred to as the premium. Figure 1.3 shows that the call option allows you a lower cost of euro purchase if EUR/USD drops below 1.3, while still ensuring that you never pay more than $130.

Perhaps you think the option costs too much. Could you give away some protection for a cheaper option? Perhaps you could have the same **option with a knockout barrier so that the option expires worthless if EUR/USD drops below 1.15 any time before the end of the year**. In this case, you will be unprotected if EUR/USD drops to 1.14 after 6 months and then rises back above the strike of 1.3 by the end of the year. (See Figure 1.4 for an illustration of this.) But then, nothing in life is free.

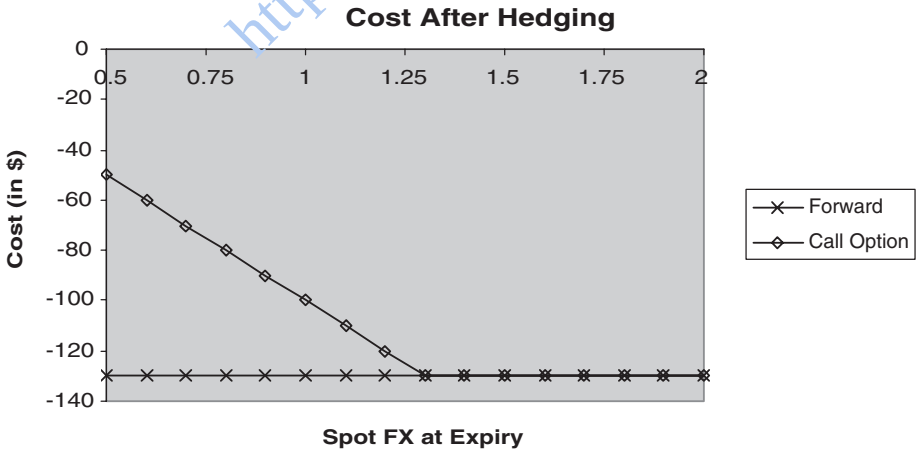

Figure 1.3 Resultant dollar payoffs when we superimpose the hedges (either forward or call option) on the short EUR/USD position (from the requirement to purchase €100). For the forward contract, the net effect is that you buy €100 at $130. For the call option, the net effect can lead to a cheaper cost of euro purchase if EUR/USD drops below 1.3.

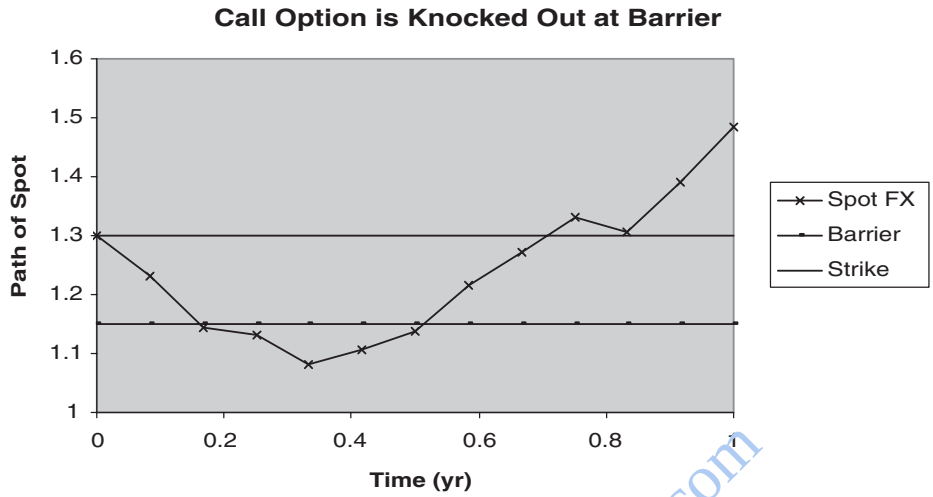

Figure 1.4 Path of spot FX. Knockout call option has barrier level 1.15. Option is knocked out at 2 months. Thus, even though at expiry of 1 year EUR/USD is above the strike of 1.3, the payoff is 0.

I hope, nevertheless, that you get the point that derivatives can be used for hedging – and optionality costs money. You can also sell some optionality, thus making the existing product cheaper.

But hedging can also be imperfect. As another example, suppose you are a huge grapefruit producer. You want to hedge your profits by entering a forward contract to sell grapefruit (i.e. a contract to sell grapefruit at a pre-agreed price in the future), so that a bumper harvest world wide in August next year will not cause depressed prices to affect you. However, you feel that orange juice contracts are much more liquidly traded, whereas the forward market cannot accommodate the volume of grapefruit you wish to sell. You also believe (or have observed historically) that grapefruit prices and orange juice prices tend to move together (at least most of the time). So instead you sell futures on orange juice (i.e. you enter into an agreement on an exchange to sell a certain quantity of orange juice next August for a pre-agreed price).

There is a significant basis risk (i.e. risk due to hedging using related assets) in that there might be a blight in oranges but a bumper harvest for grapefruit. After all, the historical relation between harvests of grapefruit and oranges may change. In this case, your grapefruit harvest will be sold at reduced prices, and yet you will lose money on the orange juice futures you have sold, since orange juice prices will spike upwards sharply. That could very well lead to ruin, so you can see that hedging may not always be the perfect solution.

It is worth pointing out that hedging tends to involve simpler products than speculation, since here you are trying to generate cashflows which protect against movements of market variables that adversely affect you, based on your existing exposure. And such exposures tend to be the result of prior simpler arrangements.

Speculation

Speculation involves taking a position in the hope of making money. If I am a dollar hedger and think that the euro will rise, I can buy euros. However, if I were a euro investor, how

should I buy more euros? Perhaps, I could sell the dollar, or buy the euro by taking a long position (i.e. an agreement to buy the asset) in a 1-year EUR/USD forward contract. What differentiates me from the dollar hedger is that I have no need to buy euros, nor to sell any dollars.

No doubt huge risks can result from speculation. For instance, you could sell short a share (i.e. borrow a share you do not own to sell it) and be exposed to unlimited loss from any rises in its price. (This has nothing to do with derivatives. Going short a forward, however, involves derivatives.) But if you have bought an option, your losses are limited to the initial premium (since you are not obliged to enter the transaction at expiry).

This rather curiously takes us to the point that derivatives need not be risky in themselves. Indeed, many (but not all) retail notes are structured such that the investor's principal (or at least part of it) is safe. Of course, an investor may at times want to surrender such protection in the hope of reaping even more significant gains. The next section will discuss structured notes, and the theme will be developed further in the book.

Key Points

- Derivatives are used for hedging and speculation.
- Hedging is aimed at protecting oneself from adverse market moves, but may not be perfect as the underlying and hedge may behave differently.
- Hedges can involve, for example, a forward (i.e. agreement to fix the price of a future transaction today), an option (i.e. the right but not obligation to enter into a future transaction), or even a knockout option (i.e. an option that can become worthless under certain conditions and is thus cheaper).
- Speculation is aimed at profiting by taking outright positions.
- Not all speculation involves derivatives (e.g. buying and selling shares); derivatives need not be more risky than cash positions (e.g. limited loss in option).

1.2 STRUCTURED NOTES

Structured products are bespoke instruments that enable investors to pursue strategies tailored to their market views. They allow an investor more control over the yield–risk tradeoff in his investment. In this section, I shall start by outlining the economic environment that encourages the growth of structured notes, and then explain them in more detail. The last decade of low interest rates (especially since 2001) has perhaps been a blessing to many (at least prior to the onset of the sub-prime crisis), but it has been a boon to others. In the days when interest rates were 7–8%, it was possible for one to earn a decent nominal yield by investing in a bond. But at 4–5%, this proposition looks much less attractive. (Figures 1.5 and 1.6 show the swap rates in the USA and Eurozone countries over the past decade.) Many pension funds pay on the basis of final salary schemes. At 7–8% nominal rates of return, their liabilities look much more manageable than at 4–5%. Indeed, many will have significant increases in their deficits unless they look to other sources of investments.

One can perhaps consider investment in equities. And indeed, there is some evidence that equities tend to outperform fixed income instruments in the long term. Figures 1.7 and 1.8 show the performances of the US and UK stock indices respectively, over the last two decades.

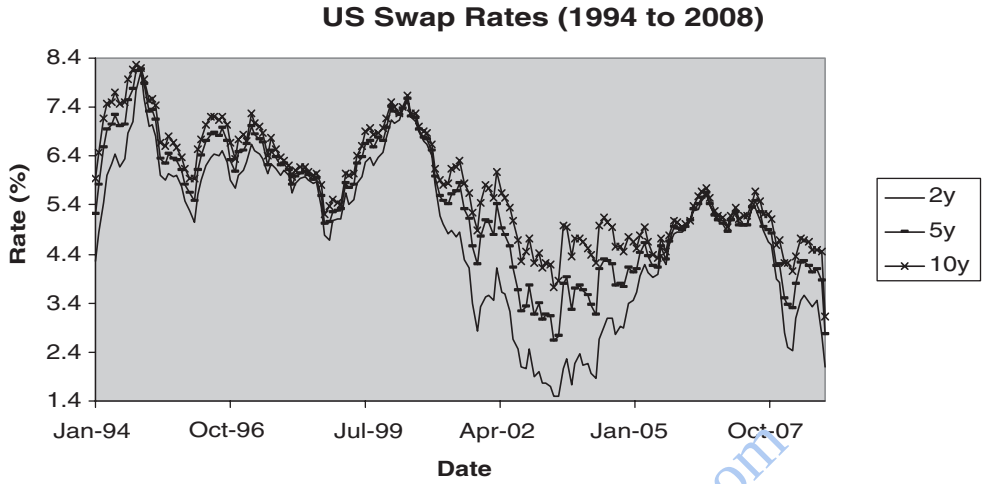

Figure 1.5 US swap rates for maturities 2y, 5y and 10y from 1994 to 2008. Notice how swap rates since 2001 have tended to be not much more than 5%, in contrast to the 7.5% around 2000 or even over 8% as in the mid-1990s.
Source: Bloomberg

Alas, it need not always hold true. A case in point is Japan. As can be seen in Figure 1.9, at its peak on 29 December 1989, the Nikkei 225 index was at 38,916. And as of 30 December 2008 (19 years later), it is merely at 8,860. In Europe, pension funds are also precluded from investing too large a proportion of their assets in equities.

Besides, after the dotcom bubble burst in March 2000, and the further deterioration of the equity markets after the 11 September attacks, an alternative to equities might seem a reasonable avenue to diversify one's portfolio. Although hedge funds have mostly filled this

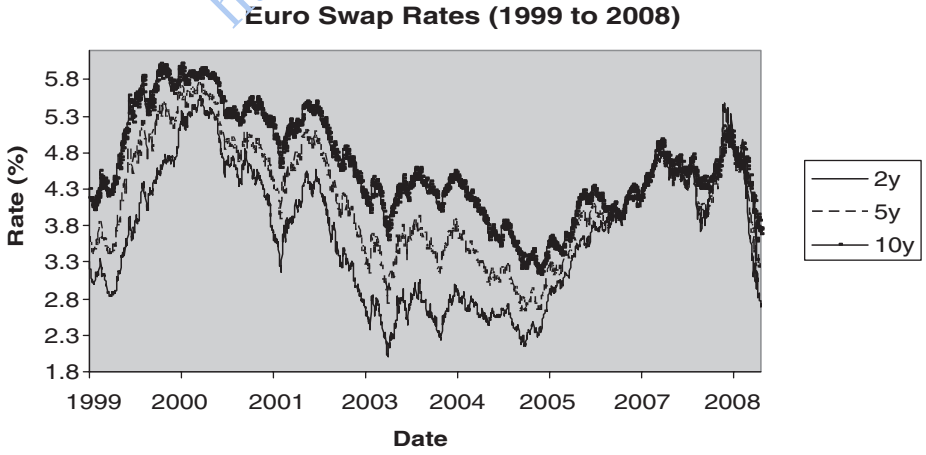

Figure 1.6 Euro swap rates for maturities 2y, 5y and 10y from 1999 to 2008. Notice how swap rates have tended to be under 5% for most of the period.
Source: Bloomberg

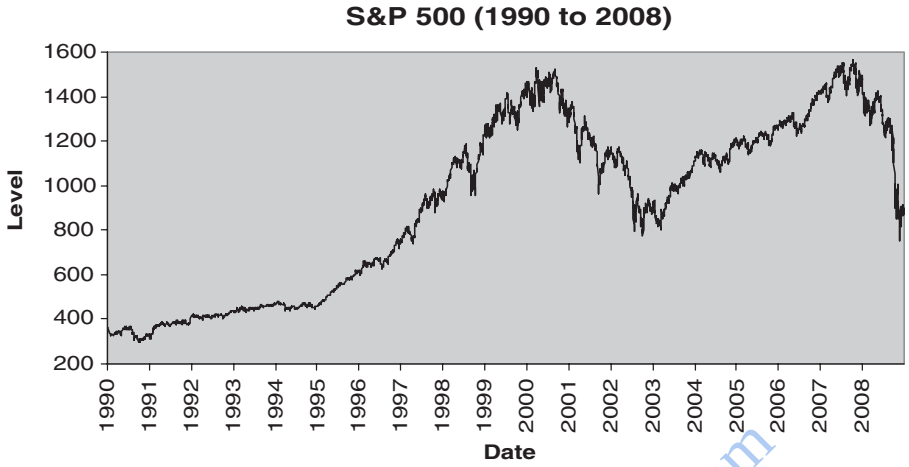

Figure 1.7 Level of S&P 500 index from 1990 to 2008. The S&P 500 index has had a meteoric rise from about 360 in January 1990 to over 1,500 by 2000, although there has been a period of decline from August 2000 to September 2003 to just over 800. Having climbed meaningful thereafter, there have been sharp declines in 2008.
Source: Bloomberg

gap, the opaque nature of their operations and their restrictive practices (e.g. lock-in periods and potential restrictions on withdrawal, especially in times of crisis) leave much to be desired.

It should also come as no surprise that structured products have catered to other investment needs. Being bespoke instruments, structured products can be used to pursue strategies involving equities, interest rates, foreign exchange, commodities, credit or real estate. Perhaps

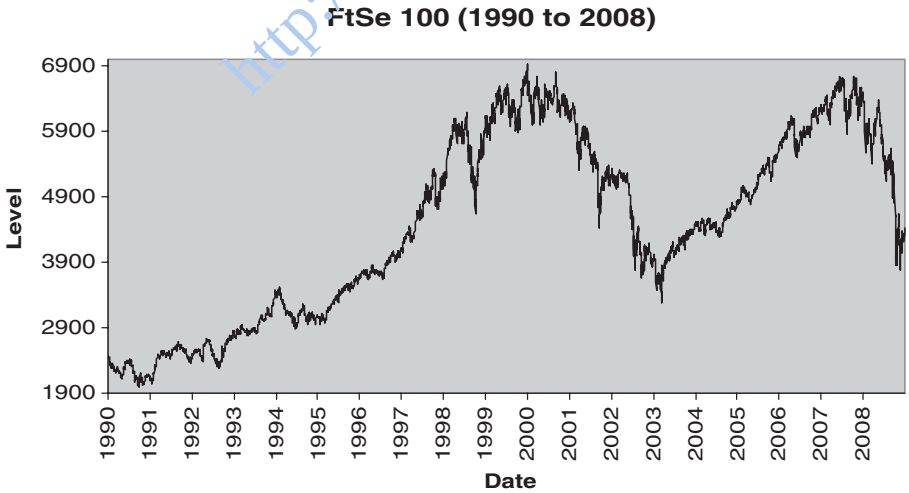

Figure 1.8 Level of FtSe 100 index from 1990 to 2008. The FtSe 100 has had a good run from 2,400 in January 1990 to a high of almost 6,900 in 2000. But like the S&P 500, the period until 2003 has been dismal, and the recovery since then has ended abruptly with the huge falls in 2008.
Source: Bloomberg

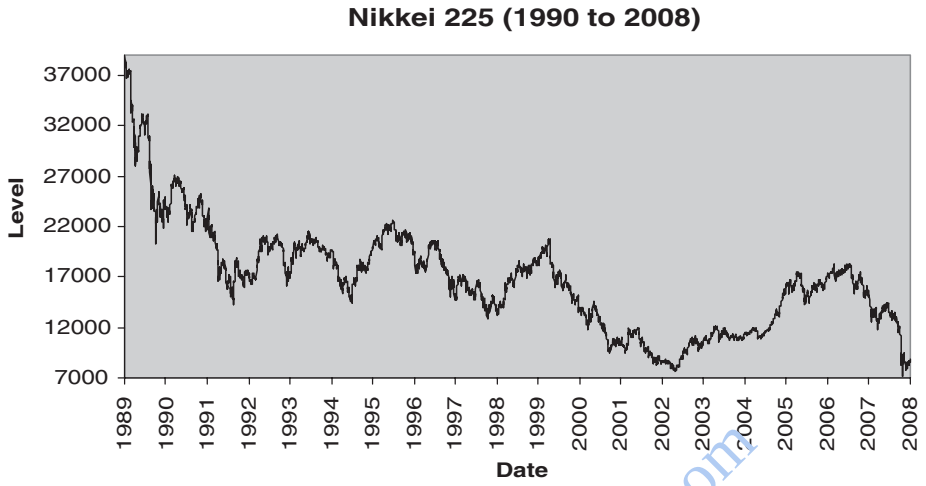

Figure 1.9 Level of Nikkei 225 index from 1990 to 2008. The Nikkei 225 index has never recovered from its peak of 38,916 on 29 December 1989. It stands only at 8,860 as of 30 December 2008.
Source: Bloomberg

an investor has a view that US inflation will stay low as per historical levels between 1.5% and 4% (see Figure 1.10). Or perhaps another investor has a view that USD/JPY will stay within historical ranges (established over the last two decades) (see Figure 1.11).

The amount of risk in structured products is very much dependent on the terms of the instrument. On one extreme, it is possible to have a contingent liability instrument where losses are not limited to one's initial investment. On the other hand, it is also possible to have notes where all (or part) of one's principal is protected and would be repaid at expiry, notwithstanding market fluctuations. In this sense, structured products often have risk profiles that are between those of a bond and a stock.

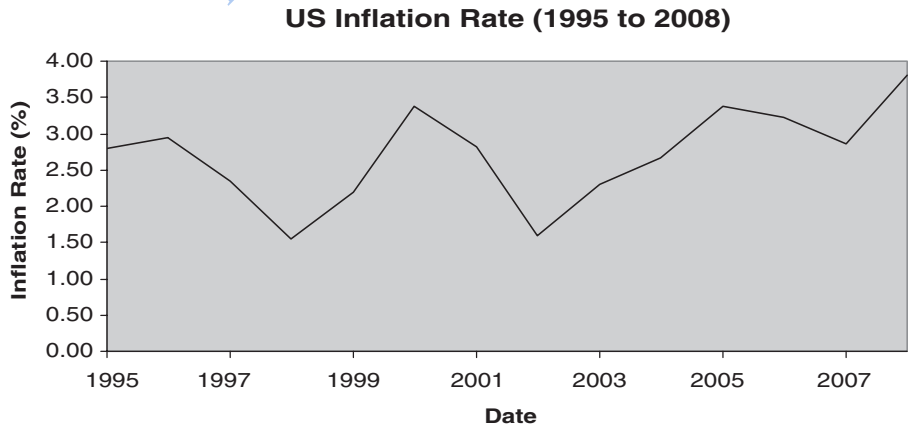

Figure 1.10 Rate of inflation in the USA (based on Consumer Price Index) from 1995 to 2008. It has been quite stable, hovering between 1.5% and 4% over the period.
Source: Bloomberg

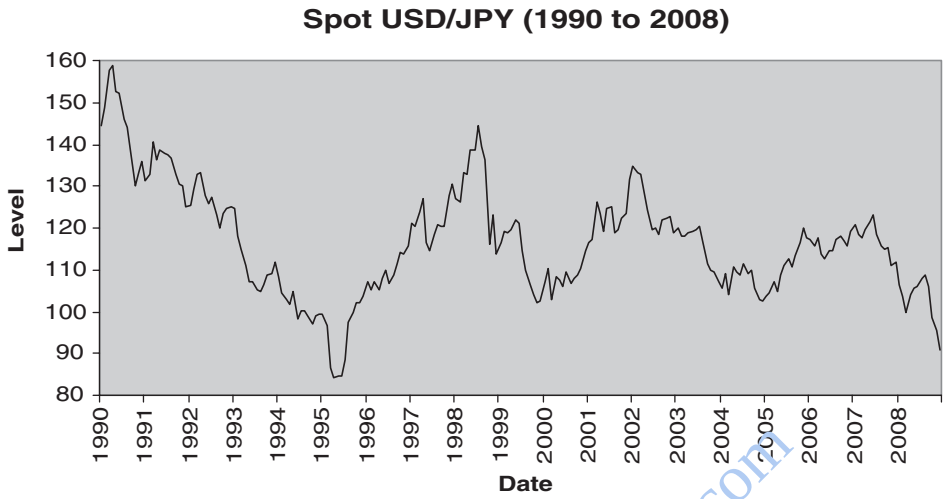

Figure 1.11 Value of spot USD/JPY from 1990 to 2008. This has ranged from a low close to 80 in 1995 to a high of 160 in 1990. However, the values have tended to be between 100 and 130 over much of the period.
Source: Bloomberg

The main idea is this: structured retail products exist because investors seek higher yield, with hopefully better control over risk.

The Concept of a Structured Note

Let me explain the basic concept. Suppose you have $1 and wish to invest it over a 5-year period. You could buy a bond and, say, get 4% interest every year. Alternatively, if you forgo the interest, your guaranteed principal is currently worth about $0.82. Figure 1.12 shows that the value of $1 paid at a future date decreases the further the payment date is. To see it another way, if you invest $0.82 now at 4% annual interest compounded yearly, it would be worth $\$0.82 \times 1.04^5 = \$1$ in 5 years' time.

You still have $0.18, which could be invested in something else. But what would you invest in? The choices are pretty limitless. You could buy a fraction of an option on the S&P 500 index. Or you could bet on the value of EUR/USD staying within some range for the next 5 years. You could go for a basket of equities in the hope that on average you will see a gain (even if one or two companies experience declines in fortunes). You could go for the difference between 10-year and 2-year euro swap rates, since historically the yield curve has usually been upward sloping, so that 10-year rates are typically higher than 2-year rates. (A swap rate is a rate pre-agreed for paying fixed coupons for a maturity, in exchange for floating coupons based on prevailing interest rates.) You could even go for the third best performer in a basket involving 5 stocks and 3 energy products.

Rather curiously, National Savings Premium Bonds (government backed) in the UK are based on the same concept of forgoing coupon interest. In this case, rather than being paid interest, the value of your interest is being entered into lottery prize draws. And the beauty is

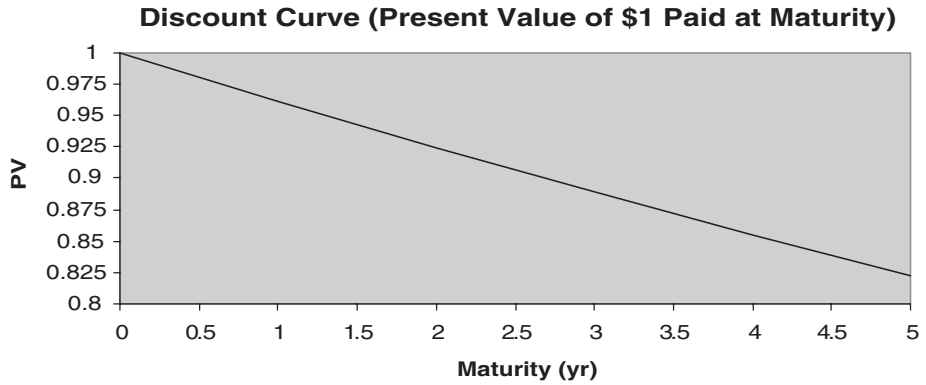

Figure 1.12 A hypothetical discount curve, showing how $1 is worth less and less as the maturity (payment date) increases. This is because you can earn interest on $1 deposited today.

that this rather disciplined gambling means that your principal is still protected at the end of all this!

Of course, if your investment only returns your principal at expiry, you are worse off than a bond holder. But for a stock holder, it is not even assured that the stock price will not fall below current level a few years from now. **So, in this sense derivatives can be used to engineer a risk profile between that of a bond and a stock.**

It should be observed that **you might not opt for full principal protection**. Perhaps you only want to ensure that you get at least 90% of the principal back at expiry. In this case, the cost is $\$0.82 \times 0.9 = \$0.74$ today, leaving you $0.26 to invest in the structured coupons. And if you are brave or greedy, perhaps you do not need any principal protection and are happy to have your principal linked to the value of some market variable (e.g. the price of oil at expiry).

There are a few other themes I wish to mention which I hope to develop further in this book:

1. Betting against forwards
2. Upside participation
3. Protected selling of optionality
4. Benefiting from correlations.

These will be more formally introduced in the next chapter.

Caveats

Some caveats must be made regarding exotic products however.

Sacrificing Principal Protection

Investors, in their pursuit of yield, have at times given up the protection of a guaranteed principal. Take for example, the case of the Power Reverse Dual Currency (which I shall discuss in detail in Chapter 10). In their quest for a higher initial coupon, Japanese investors have often agreed to be repaid their notional (typically 30 years later) not in yen (i.e. their home currency) but in US dollars at a strike somewhat higher than the forward (say at 70 whereas the forward is 50), in the event that the product does not experience early termination.

(Note that the higher strike means they get fewer yen than if converting at the forward rate, since conversion of a yen amount into a dollar amount involves dividing by USD/JPY.) They do this partly in the belief that the realised rate for USD/JPY will be higher than suggested by the forward, and that the terms are such that early termination is very likely to occur anyway. **That is all well and good provided the investors realise the potential for huge losses.** Such features render the deal no longer as safe, and indeed such modifications when they backfire, tend to give derivatives a risky reputation.

Creditworthiness of Issuing Institution

The payments on structured notes are not only subject to market conditions, but also to the credit worthiness of the issuer. Such notes are just another claim on the issuer's assets. Even **"principal protection" merely means that the principal is not subject to market conditions, i.e. as safe as the principal payment of a bond by the same issuer.**

When a company defaults, it will not repay the principal of fixed rate bonds either.

Illiquidity

It should be stressed that **structured products are usually illiquid**. They are tailor-made by banks to clients' investment preferences, and cannot be easily disposed of in a secondary market. You can get the issuing institution to cancel or restructure the contract (usually at a higher margin than the initial deal since the institution no longer has to price competitively). Alternatively, you can get another institution to prepare a structure whose cashflows offset the payments given by the earlier contract. The latter further exposes you to credit risk of both institutions. As such, it is **extremely important that the investor is comfortable with the structured product as is, and does not see disposal of it as an exit strategy**. For example, if you have a note that matures in 5 years, where you are happy with the worst case scenario, and do not need to dispose of it prior to maturity due to liquidity considerations, then it can be seen as a suitable investment. **If, however, you might need to realise cash from such a disposal in the event of coupons being less than you anticipated, you are best not to invest in the product, since disposal is likely to be more expensive than you think.**

Key Points

- The last decade saw low rates (e.g. 4–5%) in most developed economies, versus higher rates (e.g. 7–8%) from earlier periods. The immediate aftermath of 11 September 2001 also was a period of low yields and falling stock prices.
- Equities have been said to outperform in the long run but Japan is a counterpoint.
- Structured notes are bespoke instruments that can be tailored to an investor's preferences over assets, and also have been used to seek higher yields, with better control over risks.
- Principal protection is possible because $1 in the future is worth less than $1 today. If you forgo the coupons on a bond, these can be used to invest in structured coupons, while still ensuring that your principal is returned.
- Caveats include certain modifications that remove principal protection, creditworthiness of issuing institution, and the absence of a liquid market to dispose of structured notes.