

Structured note markets: products, participants and links to wholesale derivatives markets

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Hedging and taking risk are the essence of financial markets. A relatively little known mechanism through which this occurs is the market in structured notes, which have embedded derivatives, some of them very complex. Understanding these instruments can be integral to understanding the underlying derivative markets. In some cases, dealers have used structured notes to bring greater balance to their market risk exposures, by transferring risk elsewhere, including to households, where the risk may be well diversified. But the positions arising from structured notes can sometimes leave dealers 'the same way around', potentially giving rise to 'crowded trades'. In the past that has sometimes been associated with episodes of market stress if the markets proved less liquid than normal when faced with lots of traders exiting at the same time.

FOR CENTRAL BANKS, understanding how the modern financial system fits together is a necessary foundation for making sense of market developments, for understanding how to interpret changes in asset prices and, therefore, for identifying possible threats to stability and comprehending the dynamics of crises. Derivatives are an integral part of this, used widely for the management of market, credit and other risks. The associated positions and hedging strategies of banks and dealers are an important influence on how markets respond to changes in underlying fundamentals. It is perhaps less familiar that derivatives are also used by investors to take market risk in search of additional returns – often via bonds known as structured notes.

Some investors purchase such notes in order to obtain initial coupons that exceed market interest rates, receiving upfront premia for, in effect, writing options embedded in the notes. It is perhaps no coincidence that they have been as popular in recent years as they were in the early 1990s, both periods of low short-term interest rates in major currencies when some investors have been 'searching for yield'.¹ In 1994, a number of investors suffered highly publicised losses on holdings of structured notes when US interest rates rose significantly (Box 1).

For issuers, structured notes can be a way of buying options to hedge risks in their business. Most, however, swap the cash flows due on the notes with a dealer for a more straightforward set of obligations. In economic terms, the dealer then holds the embedded options. Sometimes they may hedge existing exposures taken elsewhere in a dealer's business. Alternatively, the dealer may seek to hedge by buying or selling similar options in the inter-dealer derivatives markets or through 'dynamic hedging' in the underlying cash markets. To a significant extent, so-called 'exotic' derivatives markets have developed hand-in-hand with the production and distribution of increasingly complex structured notes as intermediaries compete to offer investors new combinations of risk and return. Potentially, trading of exotic derivatives fills some 'missing markets', leading to a more efficient distribution of risk (as well as yielding information that can be valuable to central banks and others). But liquidity in such markets can still be shallow and may dry up in stressed conditions, complicating risk management.

After describing the structured note markets and discussing the motivations of investors and issuers, this article analyses the links to wholesale derivatives markets and identifies some issues relating to financial stability.

1: See the 'Conjuncture and Outlook' section of this *Review* for a discussion of the 'search for yield'.

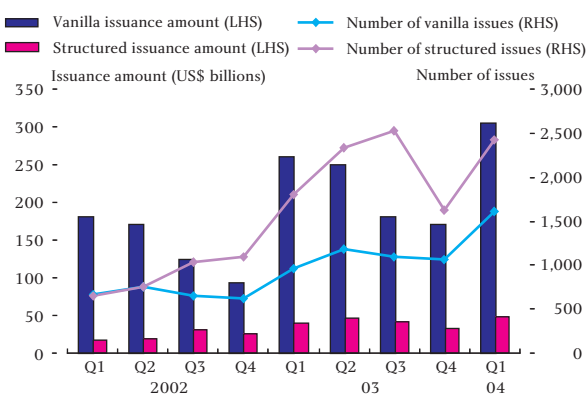
Market structure and size

Broadly, a structured note can be defined as a bond (potentially, fixed rate, floating rate or zero coupon) combined with one or more options or forwards linked to market prices or indices. They have existed for many years, but the variety of structures is almost limitless and constant innovation, at least at the level of ‘bells and whistles’, is a feature of the market.

They can take a variety of contractual forms, depending largely on the nature of the target investors (eg, nationality, regulatory and tax status). Most innovation in the structured note markets in recent years, however, has been through issuance of Euro medium-term notes (MTNs) distributed internationally.

Estimating the size of the market globally is difficult, partly because structured notes come in various forms. Data sources for new issuance of structured Euro MTNs suggest that they comprised around 15% of total MTN issuance by value in 2003 (Chart 1). But the value of outstanding structured MTNs is hard to determine because they are often callable by the issuer after an initial period (eg, twelve months). In terms of numbers of notes rather than values, more structured than vanilla MTNs are typically issued.

Chart 1:
Issuance of vanilla and structured Euro MTNs

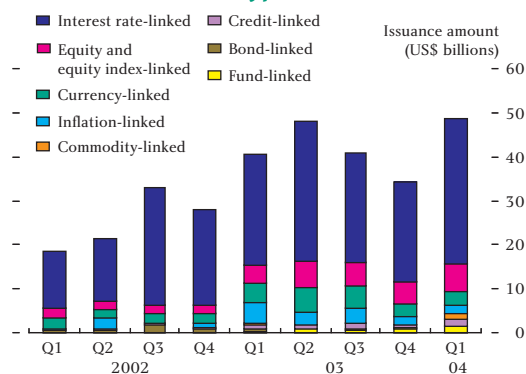


Source: mtn-i.com.

They are linked to almost every conceivable type of financial asset price, and other variables too: interest rates, equity prices, commodity prices, credit events etc (Chart 2). And they range from the relatively straightforward to immensely complex. As background to the discussion of what motivates investors and

issuers and of the links to derivatives markets, the Annex summarises the main types. The nature of the market risk exposures being transferred gives some idea of the associated exposures of dealers and investors.

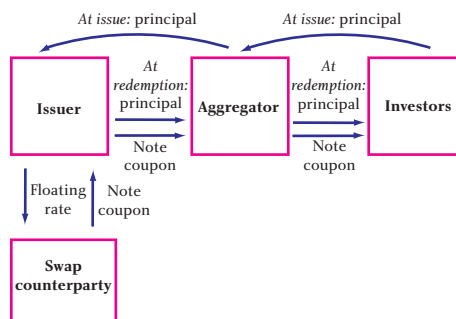
Chart 2:
Issuance of different types of structured Euro MTNs



Source: mtn-i.com.

Participants in the market include investors, issuers, swap counterparties, arrangers and distributors/aggregators. Issuers frequently enter into a swap to receive the cash-flows on the note and pay a more straightforward floating interest rate, such as a spread relative to LIBOR. Often, but not always, the swap counterparty is the dealer that arranges and distributes the notes (the arranger).² Finally, where the notes are being distributed to retail investors, they may be sold initially to distributors such as retail banks (sometimes called ‘aggregators’ because they pool together the exposures of many small investors), which will usually repackage them into retail financial products, such as tax-efficient deposits or life insurance policies (Diagram 1).

Diagram 1:
Typical structured note cash-flow structure with aggregator



2: For example, Japanese banks have been frequent arrangers of power reverse dual currency notes (see Annex) but rarely the swap counterparties.

Investors

Broadly, there are three main groups of structured note investors: high-net-worth individuals, financial institutions and retail investors.

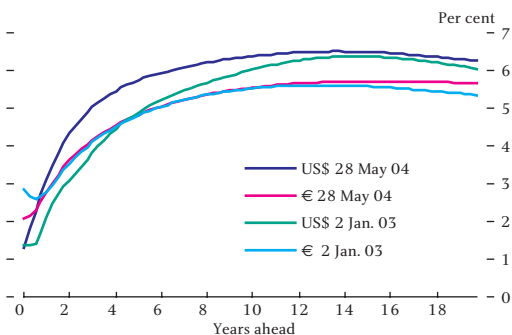
The precise pattern of demand, for each of these groups, affects the shape of dealers' derivative portfolios.

High-net-worth individuals

Many structured notes are issued in small denominations (eg, less than US\$ 10 million) for sale to high-net-worth individuals. Private banks will often approach dealers, or sometimes aggregators, on behalf of their customers in search of a particular target yield and with ideas about the nature of the risks they want to take (called 'reverse enquiry' because the initiative comes from the investor rather than the issuer or arranger). Dealers then compete to offer notes with structures that meet these requirements. Some individuals also approach dealers directly.

In the past couple of years, contacts suggest that the biggest purchases of Euro MTNs by high-net-worth individuals have been of US dollar and, more recently, euro-denominated notes – predominantly by Asian and Middle Eastern investors, as well as by customers of Swiss private banks. For the most part, these investors have been buying notes linked to US dollar or euro interest rates, selling embedded interest rate options in order to enhance the initial coupon, perhaps taking a view that interest rates would not increase as quickly as implied by the forward yield curve (Chart 3).

Chart 3:
Interest rate forward yield curves^(a)



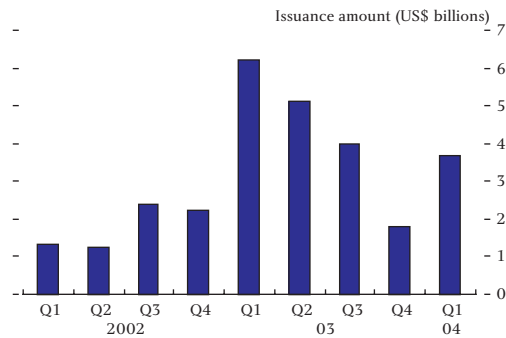
Source: Bank of England.

(a) Three-month forward nominal interest rates, derived from the Bank's bank liability curve.

A rise in such individuals' purchases appears to lie behind the increased issuance of such notes in 2002

and 2003, both in absolute terms and as a proportion of the structured note markets. For example, almost all US dollar-denominated range-accrual notes – the most frequently issued type of structured Euro MTN in 2003 – are said to have been bought by private investors (Chart 4).

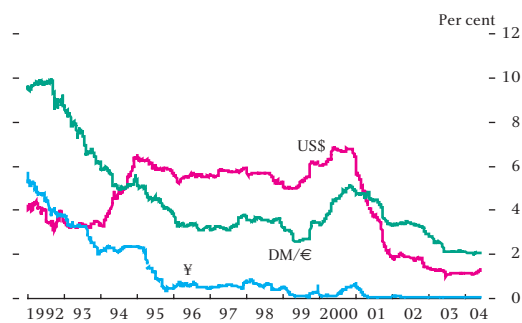
Chart 4:
Issuance of range-accrual Euro MTNs



Source: mtn-i.com.

In the US domestic market, purchases of callable notes by private investors are also said to have increased markedly. This appears to have been one manifestation of the so-called 'search for yield'. Against a background of low short-dated US interest rates (Chart 5), obtaining premia for writing interest rate options has been one way of enhancing initial coupons, taking the risk of possible sub-market returns in the future.

Chart 5:
International three-month interest rates



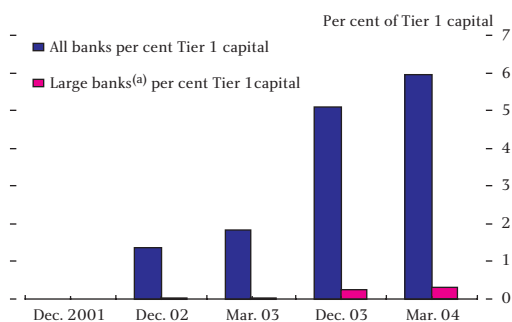
Source: Bloomberg: 3-month British Bankers Association fixings for US\$, Deutsche mark/€ and ¥.

Financial institutions

As well as high-net-worth individuals, financial institutions such as insurers, pension funds and small regional banks have also been buyers of structured notes as part of the recent 'search for yield'. In the United States, for example, a number of regional

banks and brokers in states such as Arkansas and Tennessee specialise in the distribution of callable bonds to smaller US banks and financial institutions. They have become significant players in that market and, relative to their capital, smaller US banks have bigger holdings of structured notes than do larger ones (Chart 6).

Chart 6:
Holdings of structured notes by US insured commercial banks



Source: Federal Financial Institutions Examination Council Uniform Bank Performance Report.

(a) 'Large banks' have total assets of more than US\$3 billion.

But a rather different motivation lies behind the large purchases of structured notes in recent years by European and Asian life insurance companies. As discussed in various issues of this *Review*, many have sold retail products with guaranteed nominal returns – in effect, they have sold options to their customers. These guarantees can take various forms, such as minimum returns on savings products and guaranteed annuity rates, and are often long-dated.

Although such guaranteed rates were adjusted downwards for new business as Asian and European nominal interest rates declined in recent years (Table 1), many insurers have liabilities under older contracts that guarantee returns above current risk-free interest rates.

Strategies for dealing with this problem appear to have taken two forms: either taking risk in their asset portfolios in search of above-market returns sufficient to meet the cost of their liabilities, or seeking to hedge the options they have sold by buying similar options. Insurers have used structured notes with embedded interest rate options for both purposes.

European and Asian insurers are said to be the biggest buyers of long-dated, zero-coupon US dollar and euro callable bonds – in effect, selling interest rate options to obtain higher yielding assets. They are also said to have been purchasers of other relatively high-yielding structured notes, such as equity-linked notes, credit-linked notes and notes linked to funds of hedge funds. But insurers have also used structured notes in order to *purchase* embedded long-dated interest rate options as hedges. For example, European insurers have been large purchasers of euro-denominated volatility or 'vol' bonds and bonds with interest rate floors linked to constant maturity swap (CMS) rates.³

Table 1:
Typical guaranteed interest rates on selected European life insurers' long-term savings products in 2002 compared with earlier periods

Country:	Per cent: Previous	When changed	2002
Denmark	3.0	1999	2.0
Finland	4.5	1998	3.5
Germany	4.0	2000	3.3
Italy	4.0	1997	3.0 ^(a)
Netherlands	4.0	1999	3.0
Portugal	—	1995	4.0
Spain	3.2	2002	3.1
UK	—	n/a	1.0 ^(a)

Source: European Commission 'Report of the working group on life assurance to the Insurance Committee solvency subcommittee'.

(a) Upper value of range.

Insurers may have a variety of reasons for purchasing structured notes rather than buying or selling options directly. First, they may be subject to regulatory or other prohibitions on using derivatives or making certain types of investment (eg, in hedge funds) but they may be able to purchase bonds. Second, they may prefer to purchase bonds rather than derivatives because accounting standards allow them to value bonds intended to be held until maturity at historical cost whereas derivatives might need to be marked to market. For example, some German insurers are said to prefer structured notes in the form of what are called *Schuldscheine* (promissory notes) because they are not required to mark such notes to market. Third, structured notes may offer exposures that institutions cannot easily acquire in other ways – for example,

3: A swap rate is the fixed interest rate which can be exchanged in the interest rate swap market for a series of floating rate payments (eg, LIBOR) until an agreed maturity date. Structured notes with coupons linked to CMS rates have coupon payments that depend upon the level(s) of swap rates prevailing in the market at one or more particular constant maturities at each coupon date. So, for example, the coupon might reset annually depending on the level of ten-year swap rates observed in the market on each date.

investing in commodity indices. Finally, life insurers and other asset managers with funds to invest may simply find it convenient, in effect, to combine the purchase/sale of derivatives with a purchase of a bond.

Retail investors

Savings products sold to individuals on the 'high street' by retail banks, financial advisers and others (eg, post offices and national savings banks) are often either directly backed by structured notes or hedged by structured notes purchased by the distributor or 'aggregator'. Typically, they are presented in tax-efficient forms, eg, life insurance policies in Italy or deposits such as individual savings accounts (ISAs) in the United Kingdom. Recently the biggest national markets are said to have been Italy, France and Belgium. Often such notes involve investors *buying* embedded options, so that they might obtain upside exposure to, for example, the equity market but with limited downside risk and/or principal protection. But market contacts report that issuance of principal-protected notes is not as significant in the United States, mainly on account of the large and diverse equity mutual fund sector.

The market for such notes is driven to a large extent by the current preferences of retail investors. For example, issuance of structured notes with returns linked to correlation between different equities or equity indices grew on the back of demand for such retail products offered by, amongst others, French banks since the late 1990s. In 2003, growth in issuance of structured notes linked to euro-area consumer price inflation is said to have been, in large part, a reflection of demand from Italian retail investors, who have been purchasing products with embedded purchased equity or other options and with some guarantee of the real (not just nominal) value of the principal.

Issuers

For the most part, issuers of structured notes are highly rated because investors want to take risk on the structure, not the issuer. So they are typically banks, other financial institutions, international organisations and agencies guaranteed by national governments (Table 2). They can be split into two categories, according to their motivations.

Hedging market risk exposures

Some issuers deliberately retain the associated exposures to market risk as a way of hedging exposures in the rest of their portfolio. For example, the European Investment Bank's notes linked to UK retail price inflation may partially hedge inflation-linked cash-flows in its loan book. On a larger scale, the Federal Home Loan Banks, Fannie Mae and Freddie Mac are very large issuers of callable notes as a way of purchasing interest rate options in order to hedge the prepayment risk on their holdings of US home mortgages.⁴

Table 2:
Top 15 issuers of structured Euro MTNs in 2003 and their credit ratings

	Moody's ^(a) credit rating	US\$ millions	Issues
Rabobank Nederland	Aaa	9,223	355
Kreditanstalt für Wiederaufbau	Aaa	8,133	328
Lloyds TSB	Aa2	7,324	613
European Investment Bank	Aaa	7,213	112
BNP Paribas	Aa2	6,229	764
CDC IXIS	Aaa	5,353	327
Compagnie de Financement Foncier	Aaa	4,173	65
Royal Bank of Scotland	Aa2	4,015	364
HSH Nordbank	Aa1	3,908	86
Bayerische Landesbank	Aaa	3,835	143
Commonwealth Bank of Australia	Aa3	3,682	273
Landesbank Rheinland-Pfalz Girozentrale	Aa1	2,742	30
Credit Lyonnais	Aa2	2,718	456
Dekabank Deutsche Girozentrale	Aaa	2,469	4
Depfa-Bank Europe	Aa2	2,440	221

Sources: mtn-i.com and Moody's Investors Services.

(a) Rating on senior unsecured or long-term foreign issuer debt as of June 2004.

Borrowing costs

Most issuers, however, are more passive, simply seeking to borrow inexpensively or to diversify their sources of funding. Once they have established an MTN programme, they are approached by dealers with offers of structures together with a swap so that the issuer's cost of borrowing is linked to a floating interest rate such as LIBOR.

Reflecting the attractive rates sometimes available, they have become a significant part of the wholesale funding of some large international organisations and banks, including a few large UK banks (Table 3). So

⁴ See the box on page 72 of the June 2002 Bank of England *Financial Stability Review*. An issue for these institutions is that US mortgages can typically be prepaid at any time (American options), whereas structured notes generally have European or Bermudan call options, which can be exercised at specific times only, making them an imperfect hedge.

grasping the dynamics of the structured note market has become one element in understanding how banks manage their liquidity.

Table 3:
Issuance of Euro MTNs by some UK financial institutions in 2003

	US\$ millions	Issues
Abbey	878	65
Barclays	45	5
Bradford & Bingley	5	1
HBOS	312	22
HSBC	2,332	215
Lloyds TSB	7,324	613
Northern Rock	5	1
Royal Bank of Scotland	4,015	364

Source: mtn-i.com.

Because of the swaps, issuers should not be exposed directly to market risk arising from the structure. But they do have potential exposure to the swap counterparty. This can be long-dated and difficult to value given the complexity of some notes; third party pricing services have emerged specialising in independent valuation of such swaps. In line with practice in the swaps market more generally, issuers will often demand collateral from dealers against any significant mark-to-market exposures on the swaps.

They are also exposed to some liquidity risk. Many structured notes are relatively long-dated but have call options exercisable at much shorter maturities. Issuers can, in principle, choose not to exercise call options if they are under liquidity pressure, even if the options are in-the-money, but the swap counterparty will have an identical option to cancel the swap, which it is likely to exercise in such circumstances. Choosing not to call the note would therefore leave the issuer exposed to the market risks arising from the structure over the remainder of its life.

Links to wholesale derivatives markets

As swap counterparties and arrangers, the market risks associated with structured notes are usually taken on by dealers, such as securities firms, banks or the financial products arms of a few large insurance companies. Dealers may manage these risks as part of their overall portfolio, finding existing hedges for the various dimensions of risk elsewhere in their book; or

they may seek to hedge in the wholesale markets. This might mean dealing in identical offsetting traded options if they exist. Or it might imply dealing in non-identical options thought to hedge some dimensions of the risk while not hedging some residual risks, eg, a mismatch between option maturities or differences in the definition of the underlying variable or hedging an American option with European options. Or it might mean hedging the option dynamically by buying and selling the underlying instrument (so-called 'delta' hedging).

Dealers will sometimes set out to influence the design of a structured note with the intention of obtaining market risk exposures that more or less offset existing exposures that they cannot hedge easily in wholesale markets or using other instruments. For the most part, however, the pattern of issuance is said to be driven by investor preferences – what risks they are prepared to take, what returns they are seeking and how these can be accommodated given current market prices, particularly the level of interest rates, the shape of the yield curve and the prices (implied volatilities) of different options. Innovation to find new structures that attract investors is a feature of the market, but returns to innovation are said to dissipate quickly as new structures are matched by competitors.

Demand from dealers to hedge positions arising from structured notes has encouraged the development of a number of wholesale markets. These include:

- Markets in financial variables such as inflation and real interest rates on the back of notes linked to euro-area consumer price inflation.⁵
- Trading of options exercisable on dates far into the future. For example, hedging of power reverse dual currency notes (PRDCs; see Annex) has led to trading of five- and ten-year US dollar/yen options; the market for 15-year options on 15-year euro swaps has grown partly as a result of hedging of structured note positions; and longer-dated equity-index options have developed in part to hedge equity-linked notes.
- Trading of deeply out-of-the-money options. For example, hedging of PRDCs has encouraged trading of US dollar/yen options at strikes of 90 and lower;

5: See the box on 'Inflation-protected bonds and swaps' on pages 124 and 125 in the 'Markets and Operations' section in the Summer 2004 *Quarterly Bulletin*.

and issuance of inflation-protected notes has led to trading of consumer price inflation floors at 0% in some currencies.

- Trading of exotic options with terms linked to those embedded in structured notes. For example, constant-maturity swaptions; and forward-starting options (eg, an equity-index put option exercisable two years ahead with a strike price fixed at the level of the index one year ahead – in effect, the buyer of the option is exposed to the performance of the index in year one and benefits from any rise without exposure to a fall in year two).

With a few exceptions⁶, the positions arising from structured notes can tend to leave dealers ‘the same way around’ – for example, they are either buying or selling particular types of option. Whether this imbalance leads to a corresponding imbalance of supply and demand in the market in the underlying financial instrument depends upon the scale of structured note issuance relative to that of the underlying derivative market. Broadly, an imbalance is more likely if the underlying markets for the embedded options and/or underlying instruments are small, illiquid, difficult to value (and so arbitrage) or already imbalanced in the same direction. In principle at least, crowded trades in illiquid markets, especially if combined with leveraged positions, can lead to unusual price volatility and even financial stability problems.

In well-developed and well-arbitraged options markets – such as on short-term interest rates in major currencies or on equity indices at relatively short maturities – flows from structured notes are too small to have any material effect on market pricing or dynamics. For many instruments, the stock of outstanding structured notes is likely to be small relative to outstanding over-the-counter derivative positions (Table 4).

But in less liquid markets – such as for some long-maturity options – flows from structured notes can potentially create or exacerbate a supply/demand imbalance or, alternatively, help to rectify one. At worst, many dealers can be left ‘the same way around’ with little incentive to trade with each other.

Table 4:
OTC options notional amounts outstanding and structured note issuance

OTC options (amounts outstanding US\$ billions)	End	End	End	End
	Jun. 2002	Dec. 2002	Jun. 2005	Dec. 2005
Foreign exchange	3,427	3,238	4,597	5,726
Interest rate	12,575	13,746	16,946	20,012
Equity-linked	1,828	1,944	2,311	3,186
Structured note issuance (US\$ billions)	2002 H1	2002 H2	2003 H1	2003 H2
Currency-linked	5	4	10	8
Interest rate-linked	27	49	57	36
Equity and equity index-linked	4	4	10	10

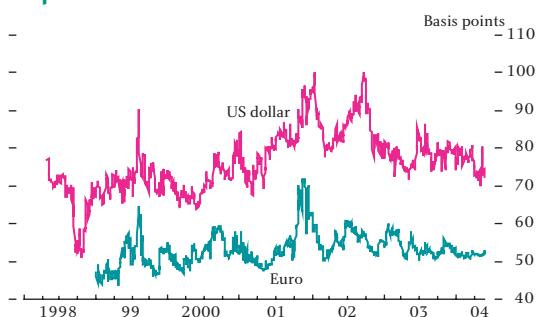
Sources: Bank for International Settlements and mtn-i.com.

The following are examples where positions from structured notes appear to have either moved markets towards or away from balance.

a. Long-dated euro interest rate swaptions

The long-dated euro swaption market is said to be more liquid, with two-way flows, than the equivalent US-dollar market. Consistent with this, the implied volatility of ten-year options to enter into ten-year euro swaps (ten-year/ten-year swaptions) has been lower and less volatile than for equivalent US dollar swaptions in recent years (Chart 7).

Chart 7:
Normalised volatilities of ten-year into ten-year swaptions



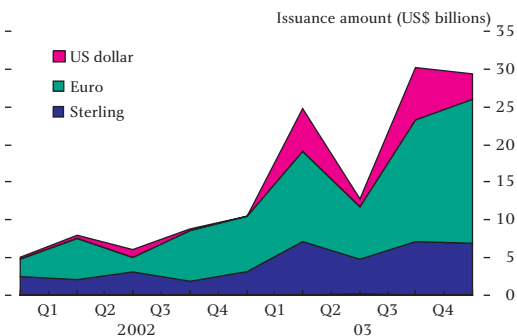
Sources: Bloomberg, Thomson Financial Datastream and Bank calculations.

There has been underlying demand to buy long-dated euro swaptions at times by European life insurance companies seeking to hedge guaranteed annuities. But issuance of long-dated euro callable bonds has enabled dealers to buy options in order to balance

6: Such as long-dated euro interest rates, on which dealers buy options embedded in some types of structured notes and sell them embedded in others.

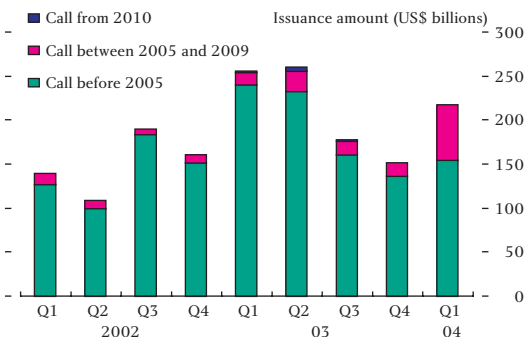
their books (Chart 8). By contrast, US dollar-denominated callable bonds typically have shorter call dates (Chart 9).

Chart 8:
Issuance of international callable bonds with first call dates 2010 or later



Source: Dealogic Bondware.

Chart 9:
Issuance of domestic US dollar callable bonds by first call date



Source: Thomson SDC and Bank calculations.

b. Five-to-ten year US interest rate swaptions

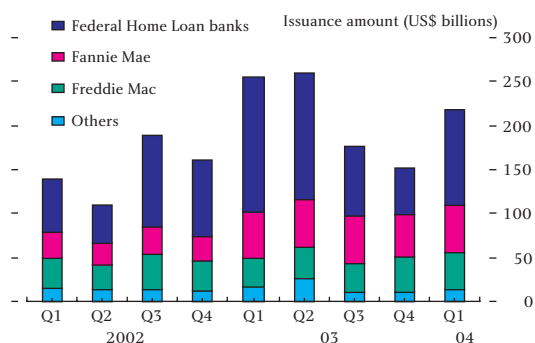
The option for US households to prepay long-dated fixed rate mortgages, free of penalty, leaves mortgage lenders and holders of mortgage bonds 'short' interest rate volatility, with models typically identifying the largest exposures at maturities of 5-10 years. One way in which they can move these books towards balance is to issue notes in which investors sell interest rate options, such as callable bonds. The growth of this market in recent years (Chart 10), has therefore helped to make the US swaption market more balanced at these maturities.

c. Long-dated equity index options

Equity-linked structured notes often involve investors buying near-the-money call options on equity indices and selling longer-maturity out-of-the-money call

options – in effect, they subsidise the purchase of upside exposure to the index by giving up the possibility of very high returns over the life of the note. Dealers are left holding long-dated, out-of-the-money call options, which trade in a relatively small market. Contacts say that the effect has been to lower the price of such options relative to other long-dated options, so that the profile of implied volatility across strikes at different index values has a 'smirk' – relatively higher for low values of the index and lower for high values.

Chart 10:
Issuance of US domestic callable notes



Source: Thomson SDC and Bank calculations.

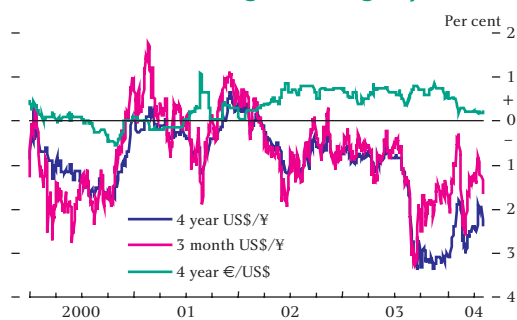
d. Long-dated US dollar/yen options

The clearest example of an options market influenced by dealers' positions from structured notes – in this case, PRDCs – is that for out-of-the-money US dollar/yen call options. Broadly, PRDCs have left dealers with substantial short option positions. With few natural sellers of such options, particularly at longer maturities, and demand dominated by dealers with the same positions, hedging is difficult and expensive. The interaction between the dealers' hedges and movements in the US dollar/yen exchange rate is complex – broadly, as the yen appreciates, the likelihood of paying a high coupon in the immediate future falls, and the expected maturity of the note increases. But it is likely that a sustained appreciation of the yen would require dealers to buy more options.

Anticipation of this potential demand may help to explain why out-of-the-money yen call options tend to be more expensive (higher implied volatility) than out-of-the-money yen put options. The ratio of these implied volatilities – known as a risk reversal – at various maturities has consequently generally been highly negative in recent years. At shorter maturities in 2003 and early 2004, this may have reflected a perceived balance of probabilities that the yen might

appreciate against the US dollar if the Japanese authorities changed their intervention policy. Indeed, when the US dollar began to appreciate against the yen in March 2004, short-maturity risk reversals did become less negative. But it is striking that longer-maturity risk reversals have remained negative, perhaps reflecting the underlying supply/demand imbalance arising from hedging of PRDCs (Chart 11).

Chart 11:
Risk reversals in foreign exchange options markets



Source: UBS.

Conclusions and issues

Structured note markets are global and multi-faceted. Because virtually any type of market risk can be embedded in a note, the markets touch most wholesale financial markets (equity, bond, foreign exchange, etc.) and embrace a variety of investors, issuers and dealers. In aggregate, flows of funds and risk transfers through the markets are probably quite significant. For the most part, the flow of funds is between investors and issuers but the risk transfer is between investors and, in the first instance, dealers.

For most *issuers*, structured notes are just another way to borrow, although they do pose particular challenges for risk management, such as controlling credit exposures to swap counterparties. They are used by many banks, including in the UK, as part of their funding and liquidity strategy.

For *dealers*, the structured note business is primarily about designing notes with embedded derivatives that investors want to buy or aggregators to distribute. But they have to manage the consequent market risk exposures. This has contributed to the development of a number of wholesale markets, particularly for longer dated, out-of-the-money and exotic derivatives. To the extent that these fill missing markets (and also

provide richer information about market participants' assessment of the probability distribution for the future values of different assets), this is welcome. A challenge for dealers is that different structures tend to be 'hot' at any one time – for example, range-accrual notes and PRDCs during 2003. Different dealers can therefore tend to take on the same market risk exposures at the same time.

In some cases, the underlying markets may be sufficiently liquid to make hedging straightforward. In other cases, the note-related positions may help to balance exposures in other parts of their business. For example, the Federal Home Loan Banks, Fannie Mae and Freddie Mac have issued US dollar callable bonds to hedge exposures to prepayment risk on US household mortgages and mortgage bonds. In effect, they have used structured notes to help re-balance their structural 'short' interest rate volatility position with the US household sector arising from the design of the US mortgage market.

But, in other cases, positions from structured notes may leave dealers 'the same way around', without a liquid underlying market in which to hedge and no offsetting exposures elsewhere in their businesses. The clearest recent example, arising from hedging of PRDCs, has been exposure to long-dated implied volatility in the US dollar/yen exchange rate, particularly in the context of a sustained appreciation of the yen. Potentially, such position concentrations may lead to sharp price movements in the relevant derivatives markets in response to changes in fundamentals. Related hedging flows could even affect underlying markets and indeed crowded trades, particularly when combined with leveraged positions, have been a source of market instability in the past. The Bank highlighted this in the June 2003 *Review*.⁷

Structured note *investors* are heterogeneous, spread across the world and have a variety of motives. But the majority by value are probably private individuals, whether rich people buying notes through private banks or people buying retail financial products on the high street that are backed by notes. Much of the risk transfer is therefore between developed wholesale financial markets and the household sectors in many different countries. For this reason, risk-taking by investors may not pose any direct concerns for financial stability since the exposures are dispersed

⁷ See Box 3 of the 'Conjuncture and Outlook' section on page 43 of the June 2003 *Review*.

Box 1: 1994 and structured notes

Between September 1992 and February 1994, the US Federal Funds target rate was 3%, and the US dollar yield curve was generally upward sloping. Some investors sought to enhance the coupons on their investments by selling interest rate options, including via structured notes, speculating that short-term interest rates would not rise as rapidly as implied by forward rates. In fact, the Federal Reserve raised its target rate to 4.25% by June and to 5.50% by the end of 1994.

By summer 1994, several money market funds sustained major losses on investments in structured notes, in some cases jeopardising the US\$1 net asset value of the funds' shares ('breaking the buck'), with one instance of a money market fund actually doing so. Colorado-based Community Bankers Mutual Fund Inc., which offered a single institutional money market fund, had invested 27.5% of its portfolio in structured notes, specifically adjustable-rate derivative securities. Beginning in March 1994, the value of the notes began to decline as a result of the sharp rises in interest rates. The fund's net asset value fell to 96 cents and resulted in the liquidation of the fund in September of that year, as the sponsor of the

fund could not maintain its net asset value above US\$1. Several other sponsors that employed similar strategies were obliged to support their funds at that time; for example, Paine Webber injected US\$268.0 million into its money market funds and BankAmerica US\$67.9 million. The SEC responded in June by instructing money managers to 'plan to dispose in an orderly manner' of any holdings of several types of structured note that involved investors selling interest rate options, including inverse floaters and range-accrual notes.

More significantly, Orange County, a district in California, declared bankruptcy in December 1994, principally as a result of losses of more than US\$1.5 billion in one of its investment pools. The investment strategy had been to enhance the relatively low short-term interest rates available in the market, by speculating that these rates would continue to remain low for some time. The investment pool not only used leverage to try to enhance returns on their investments, by using securities that had already been purchased as collateral to make further borrowings, but also invested around US\$2.8 billion in structured notes, including inverse floaters.

and outside the financial sector. The types of risk being embedded in structured notes, however, can be an indicator of risk appetite. In recent years, for example, there was a pick up in selling of embedded interest-rate options by investors, probably as one manifestation of a 'search for yield' in response to low levels of short-dated nominal interest rates. There was a similar pick-up in interest-rate related notes in the early 1990s, followed by some highly publicised problems when US official interest rates were increased in 1994 (Box 1).

One group of structured note investors within the financial sector appears to be European and Asian life insurance companies. In some cases, notes are being used to hedge options embedded in the liabilities that arise from their sometimes complex, long-dated retail savings products. In other cases, however, the investors' motive appears to be to receive higher initial coupons by taking more risk. The use of structured notes is said to reflect either restrictions on using derivatives or a desire to avoid

mark-to-market accounting standards for derivatives. Without a fuller picture of their overall assets, liabilities and capital, however, it is impossible to know whether their risk-taking through structured notes poses any wider issues for financial stability.

What is clear is that financial stability authorities need to have a broad understanding of these products and the related derivatives markets if they are to understand the distribution of market risk in modern financial markets.

Annex

Structured note markets

Structured notes can take a variety of contractual forms, depending largely on the nature of the target investors (eg, nationality, regulatory and tax status, etc). For example:

- The large domestic US structured note markets comprise predominantly callable bonds issued by entities with large US mortgage portfolios, including the Federal Home Loan Banks, Fannie Mae and Freddie Mac.
- Structured notes targeted at German investors, particularly life insurers, are often issued in the form of *Schuldscheine*.
- Notes meant for Japanese retail investors may be issued as *Uridashi* bonds.
- Large international banks will also offer customers deposits or certificates of deposit with the characteristics of structured notes.

As discussed in the main text, most innovation in the structured note markets in recent years has been through issuance of Euro medium-term notes (MTNs), which are:

- Bonds of more than one year original maturity, typically issued under programmes governed by overarching ('shelf') legal documentation under English law.
- Denominated in many currencies, but principally in US dollars and euros.
- Physical bearer securities but typically immobilised, with transactions settled over accounts at the international central securities depositories Euroclear and Clearstream.
- Private placements or listed on stock exchanges (eg, Luxembourg or Dublin). But, either way, they can be issued quickly and relatively inexpensively. This is particularly important because structured MTNs are often for small amounts and need to be issued quickly to meet the wishes of one or more particular investors.

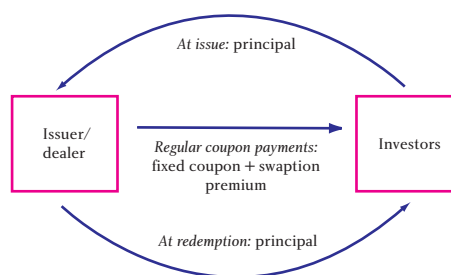
They come in many shapes and sizes, often involving complex payout structures, but the underlying building blocks usually involve investors (i) selling an option, or (ii) buying an option, or (iii) taking a view on how different asset prices or indices will co-move or (iv) doing some combination of the above.

Investors selling embedded options

Investors can increase the initial coupon on a bond by receiving a premium for taking risk via selling an embedded option to the issuer. Issuance of these types of structured note, particularly those linked to interest rates, grew rapidly in 2002 and 2003, more quickly than other varieties, and was probably one manifestation of the so-called 'search for yield' in response to low short-dated nominal interest rates.¹

One of the simplest examples of this type of note is a callable bond, where the issuer has the option to redeem (or call) the note early (Diagram 1). An issuer might exercise the option if market interest rates fell below the yield on the bond, so that it could achieve lower funding costs in the market by issuing a new bond. Investors have, in effect, sold an interest rate option to the issuer and in compensation they receive a premium in the form of a higher initial coupon.

Diagram 1:
Typical callable bond cash-flow structure

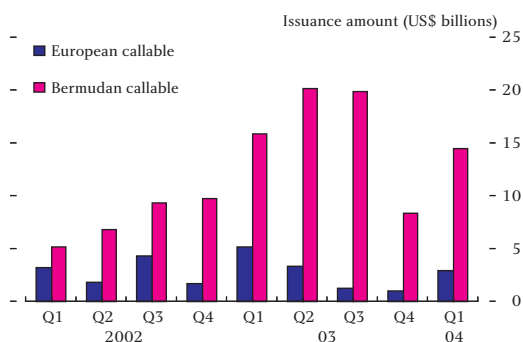


Whereas the value of a simple fixed rate bond rises when market interest rates fall, the value of a callable bond in those circumstances is capped by the call option, which, if exercised, leaves investors having to reinvest their principal at the new lower level of market rates. But the bond's value can still fall if market interest rates rise. (In other words, the bonds have 'negative convexity'.)

¹: See the 'Conjuncture and Outlook' section of this Review for a discussion of the 'search for yield'.

In the international and US domestic structured MTN markets, some callable notes – including some issued by the Federal Home Loan Banks, Fannie Mae and Freddie Mac – are callable at or any time after a certain date, similar to an American option. Other callable notes have so-called European call options, which can be exercised only on a particular date (Chart 1). An extension of the European callable bond is the Bermudan callable bond, which can be called on one of a number of dates. The number of times that such a bond can be called represents the number of call options that the investor has in effect sold to the issuer. For each additional call date, investors receive an additional option premium in the form of a higher initial coupon payment.

Chart 1:
Issuance of callable Euro MTNs



Source: mtn-i.com.

Another way of increasing the value of the option to the issuer, and therefore the initial coupon, is to extend the duration² of the bond, either by increasing its maturity or by lowering the coupon payments and issuing at a discount to face value. At one extreme, some callable Euro MTNs in recent years have been structured as zero-coupon bonds with maturities of 10-15 or even 30-50 years. When market interest rates were falling, some investors were willing to buy notes with longer duration in order to maintain initial yields at previous levels. Extending duration increases the sensitivity of the bond price to changes in market interest rates. The issuer will call the bond if it can refinance at a lower rate, which limits the scope for the price of the bond to rise if market interest rates fall ahead of the date(s) on which the call option can be exercised. Investors are therefore exposed to a risk of greater price falls if market interest rates rise without the corresponding opportunity for greater

price rises if rates fall; they earn an additional premium for taking on this risk.

One way of altering investors' exposure to interest rate risk is to add a so-called 'step up' in the interest paid on the bond if a call option is not exercised. This makes it more likely that the issuer will choose to exercise the call as the option will be 'in-the-money' unless market interest rates have risen by more than the size of the step-up. In these circumstances, investors receive the higher 'stepped-up' interest rate rather than the original rate.

Box A describes a number of other examples of structured MTNs where investors typically sell one or more interest rate options to the issuer. The detailed terms can be complex, but the essentials in most cases are that investors take a view on the pattern of future market rates relative to current market expectations implied by forward rates derived from the yield curve. This view might be about the path of short-dated rates, with the terms of the note typically linked to future LIBOR rates, or about the path of longer-dated rates, with the terms of the note linked to CMS rates. The pay-outs are often skewed, with a likelihood of the investor receiving an enhanced return (until the first call date) but some probability of a lower return, typically through a sub-market interest rate for a prolonged period (until the final maturity date) rather than any loss of principal at maturity. As the holder of one or more interest rate options, the issuer – or the dealer to which the issuer has on-sold the embedded option – benefits from greater volatility in market rates whereas investors benefit from stability.

Although most structured notes in which investors 'sell' options have typically been linked to interest rates, other types of underlying are common, including equity prices or indices, exchange rates, commodity prices and credit events. To give two examples:

- A **reverse convertible** is a structured note in which investors sell an embedded equity put option to the issuer (Diagram 2a). If the price of the underlying equity or equity index is lower than the strike price, the issuer is likely to exercise the option and deliver to investors a predetermined number of shares (or a

2: Duration is the weighted average maturity of the expected cash flows (interest and principal) on the bond, where the weights are the present values of these cash-flows.

Diagram 2a:
Reverse convertible note cash-flow structure – equity level above strike price

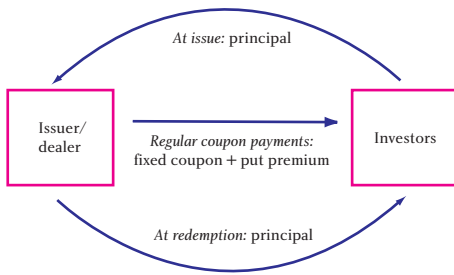


Diagram 3a:
Credit-linked note cash-flow structure – without credit event

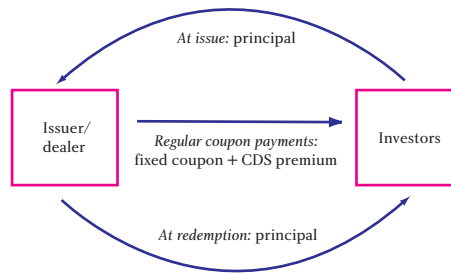


Diagram 2b:
Reverse convertible note cash-flow structure – equity level below strike price

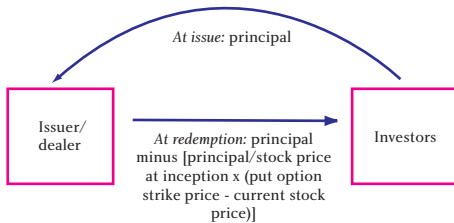
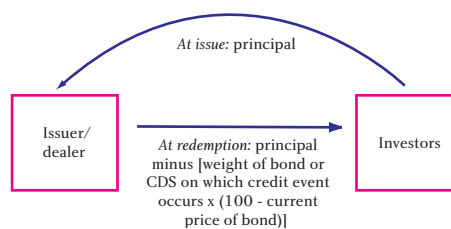


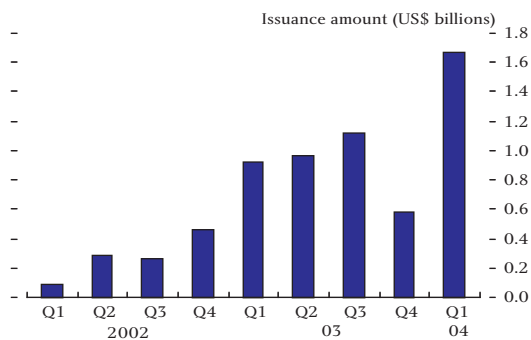
Diagram 3b:
Credit-linked note cash-flow structure – with credit event



cash equivalent) instead of repaying the face value of the note in cash (Diagram 2b). Investors are therefore exposed to potential losses should the value of the equity or equity index fall below a certain level (the strike price).

- A **credit-linked** note includes an embedded credit derivative sold by the investors (Diagram 3a). If a specified company or sovereign suffers a credit event, the face value of the note is reduced, depending on the recovery value of the defaulted debt (Diagram 3b). Often credit-linked notes are linked to ‘baskets’ of names so that, if any of the names in the basket experiences a credit event, investors suffer the same loss as they would if the note were the debt of the defaulted entity (a ‘first to default’ basket), depending on the weight of the defaulted entity in the basket under the terms of the note (Chart 2).

Chart 2:
Issuance of credit-linked Euro MTNs



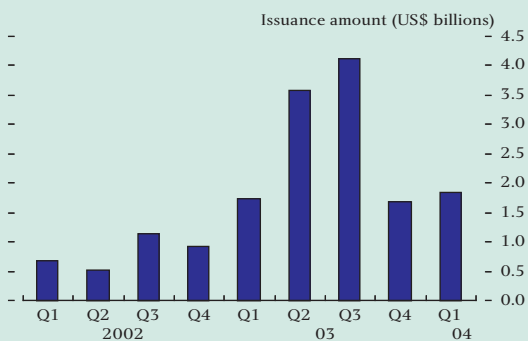
Source: mtn-i.com.

Box A: Variants of structured notes where the investor is taking interest rate risk

Floating rate notes (FRNs) have coupon payments that reset periodically depending on the level of reference market interest rates such as LIBOR rates. Some notes have caps on the interest rate paid, where investors in effect sell the issuer an option, with the 'premium' either monetised in the form of a higher initial coupon (spread over the reference rate) or used to purchase an interest rate floor. FRN investors benefit if market interest rates rise more rapidly than implied by the forward curve at the time of issuance. FRNs can also be leveraged – for example, paying a multiple of LIBOR less a fixed rate but with an interest rate floor of 0%; or de-leveraged, with the investor receiving a higher spread over the reference rate in exchange for agreeing to receive only a proportion of any increases in it.

Inverse FRNs also have coupon payments linked to reference market interest rates but they rise if the reference rate falls and vice versa (Chart A). The notes typically pay a fixed interest rate less the reference rate – in effect, an interest rate swap in which investors pay floating and receive fixed – but with a floor of 0%. Inverse FRN investors benefit if market interest rates rise less rapidly than implied by the forward curve. Similarly to FRNs, inverse FRNs can include interest rate caps and floors and varying degrees of leverage.

Chart A:
Issuance of inverse FRN Euro MTNs



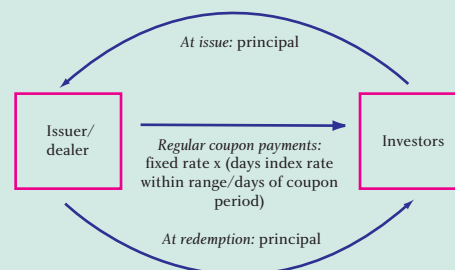
Source: mtn-i.com.

Ratchet notes are FRNs or inverse FRNs that have a maximum limit on the amount by which coupons can increase from the previous coupon level. Investors have sold a path-dependent option to the issuer, perhaps taking the view that market interest rates

might not rise as rapidly as implied by the forward curve.

Range-accrual notes (also known as range notes or corridor notes) accrue interest at different pre-specified rates, depending on the level of reference market interest rates, typically LIBOR. Most range notes have a high and a low accrual rate: the higher accrual rate is paid for every day that the reference rate remains within a designated range. The lower rate, often 0%, is paid during periods that LIBOR settles outside that range (Diagram A). By purchasing one of these notes, the investor has sold a series of digital, or binary, options: one with a strike price at the high end of the range and another with a strike price at the low end of the range. But range notes also exist in which the investor sells two barrier options: one where the interest payment becomes zero if the reference rate falls below a certain level, known as a down-and-out; and the other where the interest payment becomes zero if the reference rate rises above a certain level, known as an up-and-out. These upper and lower limits can apply for each coupon accrual period, where if the reference rate crosses either barrier on even just one occasion, the investor's coupon drops to zero for that period. Or, for some notes, the range can apply for a longer pre-determined period, or the whole life of the note, which could lead to zero interest on the note for much longer periods or even throughout the life of the bond. Investors are clearly taking a view on the future volatility of market interest rates.

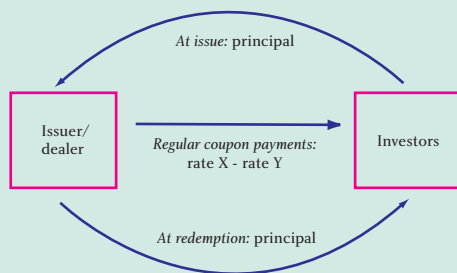
Diagram A:
Range-accrual note cash-flow structure



Dual-index notes are typically used to speculate on the shape of the yield curve (Diagram B). For example, investors might take the view that the yield curve will

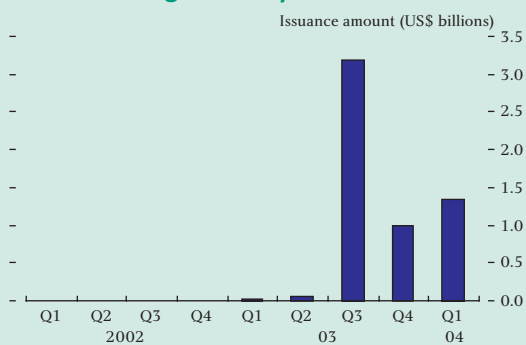
steepen and that the difference between the ten-year swap rate and the five-year swap rate (ten-year minus five-year) will be greater in the future than it is today. In this case, an investor might purchase a note with a coupon linked to the difference between five- and ten-year constant-maturity swap rates, but with a floor of 0% if this difference is negative.

Diagram B:
Dual index note cash-flow structure



Target redemption notes are typically FRNs or inverse FRNs that redeem early if the total interest paid to investors to date reaches a certain 'target' threshold (Chart B). In exchange for this option sold to the issuer, the notes might include an initial period of fixed coupon payments at a rate exceeding market interest rates (Diagram C).

Chart B:
Issuance of target redemption note Euro MTNs

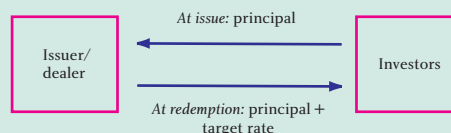


Source: mtn-i.com.

Index-amortising notes can be FRNs, inverse FRNs or fixed-coupon notes but with the feature that some or all of the principal is repaid early each year, depending on the level of a reference rate (eg, LIBOR). Often US dollar index amortising notes prepay more slowly as market interest rates rise and more rapidly as they fall, giving them similar characteristics to US mortgages. Large holders of

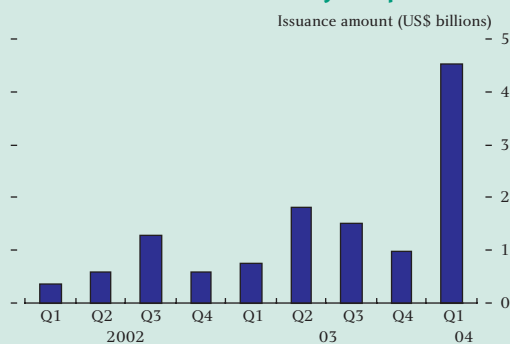
US mortgages, such as Fannie Mae and Freddie Mac, therefore, issue these notes to hedge their mortgage prepayment risk.

Diagram C:
Target redemption note cash-flow structure



In addition to LIBOR, **constant maturity swap rates** have increasingly been used as a reference interest rate for a variety of interest-rate-linked structures, including range accruals and target redemption notes (Chart C).

Chart C:
Issuance of constant maturity swap-linked Euro MTNs

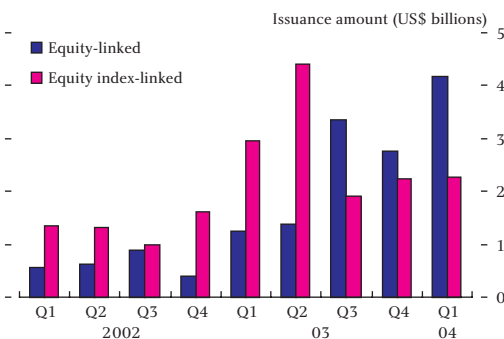


Source: mtn-i.com.

Investors buying embedded options

Another broad category of structured notes involves investors *purchasing* embedded options linked to risky underlying instruments (eg, equity indices). In effect, they exchange some proportion of the future cash flows on the bond for more uncertain but potentially higher returns, depending on the future value of the option (Chart 3). Typically, the structures involve investors giving up some or all of the coupons on the bond to purchase options, but leave the principal repayment intact so that the note, in effect, comprises purchased call options and a zero-coupon bond. These notes are often sold as (nominal or real – see below) principal-protected investments in, for example, equities. Issuance of such notes grew rapidly in continental Europe in the late 1990s, as equity markets rose strongly. But it has since been steadier, although higher in 2003 than 2002.

Chart 3:
Issuance of equity-linked Euro MTNs

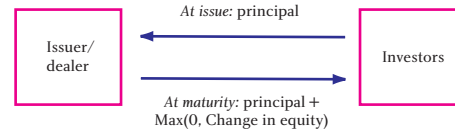


Source: mtn-i.com.

For a typical equity-linked note, investors purchase call options on an equity stock or an equity index (Diagram 4). The value of options that they can purchase depends on the present value of the foregone interest payments and the cost (partly related to implied volatility) of the options – it will be greater the longer the maturity of the note, the higher the level of nominal bond yields and the lower the equity implied volatility. In order to reduce the cost of the call options, investors can purchase fewer call options at the strike price (eg, the current or at-the-money level of the index). But this lowers the potential return on the note and investors receive only a percentage of any increase in the equity or index level: for example, if the index increases by 10%,

with a so-called participation rate of 70% of any increase, investors receive a return of only 7%.

Diagram 4:
Equity-linked note with principal protection cash-flow structure



Alternatively, the investor may wish to purchase less expensive call options (out-of-the-money call options) where the payoffs rise in line with increases in the equity or index but only once a certain level has been reached. Another common approach is to subsidise the purchase of at-the-money call option(s) by selling out-of-the-money call option(s) to the issuer. This has the effect of allowing the investor to receive 100% of a rise in the index up to a certain level. Some equity-linked notes are also callable, either at the issuer's discretion on one or more dates or if a certain trigger level in the equity price or index level is reached or when cumulative interest payments on the note reach a threshold level ('target redemption' notes).³ This is another way of subsidising the purchase of at-the-money or close-to-the money call options.

Similar structures, combining investment in risky assets with principal protection, are sometimes linked to assets other than equities. This year, for example, notes linked to commodity indices (eg, the Goldman Sachs Commodities Index and the Dow Jones-AIG Commodity Index, which include energy, industrial metals, precious metals, agriculture and livestock) have been popular.⁴

Another example is notes based on funds of hedge funds. But, given the absence of traded call options on hedge fund returns, such notes may be backed by direct investments into a fund of hedge funds or a hedge fund index combined with purchases of highly rated zero coupon bonds. Alternatively, and more frequently, funds are allocated dynamically between hedge fund investments and bonds, depending on returns on the hedge funds and changes in bond

³: The payoff of a target redemption note is linked to the cumulative performance of the underlying equity index. The note is redeemed when some specified expiration date is reached or the accumulated coupon reaches a pre-determined target redemption level, whichever comes first (Box A).

⁴: According to mtn-i.com, there were more than 50 commodity-linked Euro MTNs issued in 2004 to date, amounting to more than US\$1 billion.

yields, in an attempt to ensure that the notes do not fall below their face value.⁵ Initially, the investment in hedge funds might be nearly 100%, but funds would be reallocated to bonds progressively as either the value of the investment or bond yields fell. Leverage can be employed to increase the initial allocation to hedge fund investments but this necessitates ‘steeper’ ‘stop loss’ triggers so that funds are reallocated into bonds more rapidly if the value of the investments falls. Dynamic hedging is intended to mimic the payoffs on a purchased call option on the underlying hedge fund investments, although it works only if it is possible to buy and sell the investments continuously. A financial institution, such as a bank or insurance company, may sometimes take on this risk by guaranteeing noteholders principal repayment at maturity.

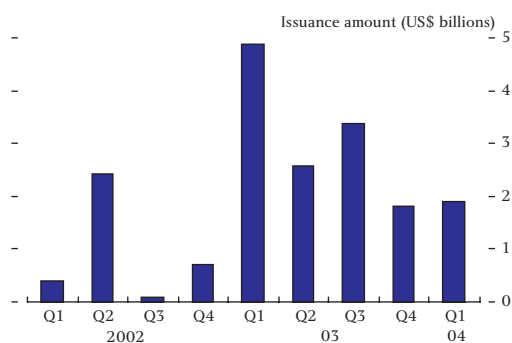
As an alternative to protecting only the nominal value of their principal at maturity, investors may also choose to protect its real value by investing in inflation-protected bonds (Chart 4) or by converting the nominal cash-flows on conventional bonds into real cash-flows using inflation swaps. Structured notes may either combine inflation protection with other embedded options (eg, purchased equity index call options) or be more straightforward inflation-protected notes, purchased by, for example, retail banks to hedge inflation-protected savings products.

contingent exposure only to the size of these changes, irrespective of the direction. In effect, they gain exposure to the volatility of the asset. An example is a so-called volatility (or ‘vol’) bond, on which the coupon is linked to the absolute size of the change in a market interest rate (eg, LIBOR or a CMS rate), regardless of direction, since the previous coupon payment date. So investors benefit when interest rates are volatile. In effect, investors have purchased a combination of put and call options on market interest rates.

Co-movement between asset prices or indices

The payoffs on another category of structured notes are linked to the *co-movement* of returns on different underlying instruments. Typically, returns on these notes are linked to price changes on a basket of individual stocks or movements in a basket of equity indices (Chart 5). In some cases, investors benefit more if the relevant prices/indices move together – investors are ‘long correlation’. In other cases, they benefit more if they diverge – ‘short correlation’. Issuance of these types of note began in the late 1990s. Recently, some notes have been linked to the co-movement of returns on different types of financial assets, known as ‘hybrids’. For example, a note might have payoffs linked to a number of equity, commodity, credit and government bond indices.

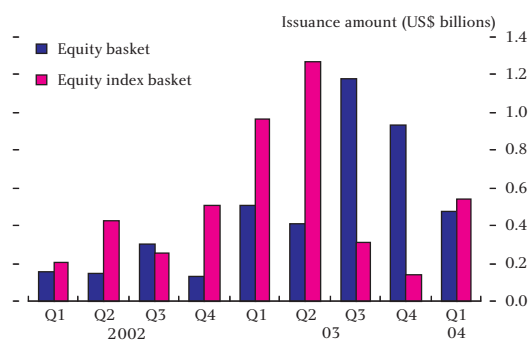
Chart 4:
Issuance of inflation-linked Euro MTNs



Source: mtn-i.com.

Although most structured notes in which investors purchase embedded options give the investor contingent exposure to the direction and magnitude of changes in the level of the underlying asset, there are some structured notes in which investors gain

Chart 5:
Issuance of equity and equity index basket-linked Euro MTNs



Source: mtn-i.com.

In ‘best of’/‘worst of’ structures (Box B), returns depend on relative returns within a basket of assets, such as a number of individual stocks or different equity indices. In a typical ‘best of’ structure, the total return over the life of the note is the average of the returns on the best performing constituent stock

5: See page 72 of the ‘Financial stability conjuncture and outlook’ section of the June 2001 *Review* for a discussion of principal protection.

Box B: Best of/worst of products

A simple example of a ‘best of’ structure is an ‘outperformance basket’, in which the pay-off on the note is linked to the number of basket constituents whose prices rise by more than the market index over a defined period. Another more complex example is a ‘Himalaya’. At the end of the first period, the performance of the best performing asset or number of assets is recorded and the asset(s) is/are dropped from the basket for future periods. In each subsequent period, the procedure is repeated. At the end of the note’s life, the arithmetic mean of each recorded best performance is calculated in order to determine the payout. Investors benefit from both price volatility and correlation over the term of the note:

- the more volatility there is in the market the more likely the constituents will have risen significantly at some time during the period, to record a series of high best performers;
- correlation is less important for each period, as it is only the performance of the single best performing

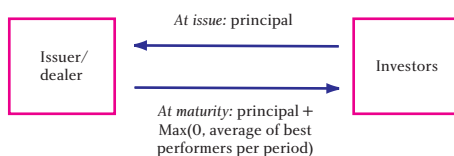
constituent that matters, but given that after each period the best performer is removed, the basket needs to be composed of stocks that are all expected to perform well, at least at some point during the life of the note.

A variation on the ‘Himalaya’ is the ‘Emeraude’, on which the average price change of the assets in the basket at the end of each period is recorded, and the final payoff of the note depends on the highest of all these periodic averages. Investors stand to gain from asset returns being high and highly positively correlated in at least one period over the life of the note, irrespective of the collective or individual performance of the assets in all other periods.

An example of a ‘worst of’ structure is an ‘Everest’, on which payoffs are linked to the price changes of one or more of the worst performing stocks from the selected basket. This structure is highly sensitive to volatility: a significant underperformance of just one asset, more likely if volatility is high, can significantly reduce the return on the note.

or index during each of a series of pre-defined periods throughout the life of the note (Diagram 5). This means that, as far as each period is concerned, the investor benefits most when the stocks are negatively correlated, as this increases the probability of each period having at least one stock performing well.

Diagram 5:
Note linked to basket of assets (‘best of’) cash-flow structure



In ‘worst of’ structures, by contrast, returns are linked to the changes in prices of those constituent stocks or indices that have risen the least – other things being equal, investors benefit from positive correlation, obtaining the highest returns when the prices of all stocks rise together.

For example, assume the basket comprises two stocks (A and B), and there are two periods. If in period 1 A rises 25% and B rises 5%, and in period 2 A rises 5% and B rises 25%, the return on the note would be $(5\% + 5\%)/2$ or only 5%. But, if in period 1 both A and B rise 10%, and in period 2 both A and B rise 8%, ie the stocks are positively correlated, the return would be higher, $(10\% + 8\%)/2$ or 9%, despite the fact that over the two periods the two stocks individually have risen by less.

Combination products

Some of the more complex structured notes involve combinations of investors buying and selling options on different underlying instruments. One popular variant this year was notes with payoffs linked to exchange rates but with knock-out options⁶ linked to, eg, the price of a commodity such as gold or oil or an equity index.

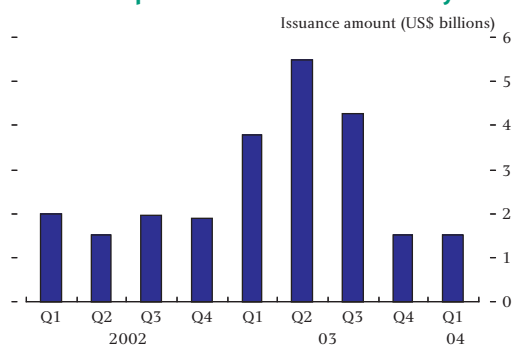
Another prominent example is **power reverse dual currency notes (PRDCs)**, created in response to the desire of some Japanese investors to receive an enhanced initial coupon against a background of very low yen nominal short-term interest rates (Table 1 and Chart 6).

Table 1:
Top ten dealers of power reverse dual currency Euro MTNs in 2003

	US\$ millions	Issues
Mizuho	3,219	399
Nomura	2,651	245
Citigroup	1,672	170
Daiwa SMBC	1,587	176
Not disclosed	1,265	194
JP Morgan	819	86
Bank of Tokyo Mitsubishi	583	79
Credit Lyonnais	567	78
Goldman Sachs	486	65
Shinkin	304	25

Source: mtn-i.com.

Chart 6:
Issuance of power reverse dual currency Euro MTNs

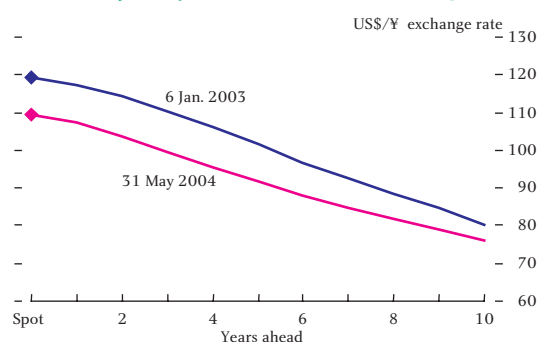


Source: mtn-i.com.

The history of PRDCs, which have been widely discussed as a potential source of stress in some markets, illustrates how structured notes can evolve,

adding complexity and with investors taking on greater risk in order to receive higher initial coupons relative to prevailing risk-free rates. The forerunners of PRDCs were dual currency notes and reverse dual currency notes. Dual currency notes pay the coupon in the currency of the investor and the principal in the currency of the issuer, meaning that the investor is exposed to foreign-exchange risk only at maturity. These first became popular with Japanese investors in the late 1980s. Investors are speculating that the yen will not appreciate against the US dollar in line with the path implied by forward interest rate differentials (Chart 7).

Chart 7:
US dollar/yen spot and forward exchange rates



Source: Bloomberg.

In contrast, reverse dual currency notes repay principal in the investors' domestic currency (in this case yen) but link coupon payments to short-term interest rates in an overseas currency (eg, US dollars, but also other currencies, notably Australian dollars).

As yen interest rates fell lower still in the 1990s, the reverse dual currency bond structure was adapted in various ways so that investors could continue to take the same speculative view but obtain a higher fixed initial coupon by taking more risk (hence the addition of 'power' to the name). Issuance of PRDCs reached more than US\$9 billion in the first half of 2003, comprising a large but – because the investors were almost entirely Japanese – segmented part of the structured note markets.

PRDCs have had many different 'bells and whistles' but the main steps from the simpler reverse dual currency note have been:

6: Knock-out options are a variant of barrier options, which either come into existence (knock in) or cease to exist (knock out) if the price of the underlying asset reaches or crosses a specified (or barrier) level that is different from the strike price.

- Linking the level of the coupon to the level of the US dollar/yen exchange rate, so that the coupon rises if the yen depreciates against the US dollar below a threshold level but falls to zero if it appreciates above that level. In effect, investors buy a series of call options on the US dollar/yen exchange rate with strikes at the threshold level.⁷
- Giving issuers a series of call options to prepay the notes, limiting the upside to investors beyond the first coupon date.
- Lengthening the final maturity of the notes, so that investors are potentially exposed to a long period of low coupons (with a minimum of 0%) before the notes are repaid if issuers choose not to call the bonds early, which would be most likely following a sustained appreciation of the yen against the US dollar. Many PRDCs have had final maturities of 30-50 years.
- Adding barrier options⁸ that, if triggered, give the issuer further options to call the bonds early. For example, an option might 'knock in' if the yen depreciates against the US dollar beyond a certain threshold. Again, investors receive a higher initial coupon in exchange for giving up some future 'upside'.

7: As a result, the basic coupon structure is as follows –

$$coupon_t = \max \left[\frac{S_t}{S_0} C_{\$} - C_{¥}, 0 \right]$$

where $C_{\$}$ and $C_{¥}$ denote the US dollar and yen coupons respectively, S_t denotes the exchange rate just before the coupon payout date and S_0 denotes the reference rate set at the purchase time of the bond. For example, with a US dollar and yen coupon of 15% and 10% respectively, the enhanced coupon will be 5% if the US dollar/yen exchange rate is the same as the reference rate, 20% if the US dollar/yen exchange rate is twice the reference rate, and nothing if the US dollar/yen exchange rate drops more than 33.3% below the reference rate.

8: See footnote 6.