Role and importance of interest rate derivatives

Since being introduced in the late 1970s, interest rate derivatives have become indispensable instruments of risk management on the financial markets. This has not been without consequences for the structure, price formation and liquidity of the relevant cash markets. Derivatives take away transactions from the cash market while also creating new trading opportunities. Thanks to lower trading costs, information is reflected in prices on the futures markets sooner than on the cash market. Liquid derivative markets thus have a tendency to raise the efficiency of the financial markets. Under certain conditions, however, the major leverage effect of derivative financial instruments may also have a destabilising impact. The following report first explains the development and structure of the markets for interest rate derivatives and then the impact of the increasing use of derivatives on the stability of the financial system and the monetary policy transmission process.

Introduction

Sharp growth in the market for interest rate derivatives ...

"Interest rate derivatives" is the general term for instruments whose value is derived from the market price of a debt security or a reference interest rate. These include bond futures, their related options as well as interest rate swaps. In April 2001, daily turnover in interest rate contracts on the derivatives exchanges was in the order of US$2.2 trillion,

almost double its value in the mid-1990s. The rates of growth in over-the-counter (OTC) trading have been even greater, with its turnover of interest rate derivatives more than tripling during the same period to US$0.8 trillion. At the end of June 2001, the nominal value of all open interest rate contracts – traded on exchanges and OTC – was, at US$93 trillion, several times higher than the nominal value of all bonds outstanding (US$36 trillion).[1,2]

... raises questions about the implications for monetary policy

The Bundesbank investigated the monetary policy implications of derivatives as early as November 1994.[3] Back then, the article came to the provisional conclusion that monetary policymakers could take a relaxed view of the increasing use of derivative financial instruments. At the same time, however, a careful analysis of these markets was urged. Now that extensive statistical central bank surveys of the banks' derivative business are conducted every three years, with their results published by the Bank for International Settlements (BIS), the available database – which also covers the OTC derivatives market – is much better than in 1994. Additionally, since 1998, there have been supplementary semi-annual derivatives statistics, which are likewise collected by the national central banks and coordinated by the BIS.

Characteristics of derivatives

The key characteristic of derivatives is that their use makes it easier and more cost-effective to split off the risks associated with the underlying financing instruments and to trade them separately. Some types of derivatives, such as futures contracts and swaps, may, in principle, be replicated by a combination of their underlying securities or interest rate contracts. In practice, however, this entails considerable transaction costs and is therefore uneconomic for the individual investor. For that reason, derivatives are often the only possibility of trading a given combination of risks. This is all the more true of derivatives with option characteristics, the risk profile of which cannot practically be reproduced by a combination of underlyings.

Significance of derivatives from a micro-economic ...

According to a 1997 survey, more than three-quarters of the surveyed German enterprises use – mainly currency and interest rate – derivatives.[4] The popularity of derivatives is due to the fact that they tie up much less capital than do positions in the underlying assets. This results in these instruments having a major leverage effect. They may be used to reduce risks (hedging) or to take on risks intentionally. The derivatives markets allow enterprises, for example, to separate the operational policy risks of an investment from the interest rate risk so as to make operating performance less dependent on factors outside their sphere of influence. They allow banks – whose interest rates on their assets are typically locked in for a longer period than those

1 Owing to the strong leverage effect of derivatives, these figures do overstate the importance of the futures market, however.
2 Source: central bank survey. See Bank for International Settlements (BIS), Triennial Bank Survey: Foreign Exchange and Derivatives Market Activity, March 2002 and various issues of BIS, *Quarterly Review*.
3 Deutsche Bundesbank, The monetary policy implications of the increasing use of derivative financial instruments, *Monthly Report*, November 1994.
4 The survey covered 368 large and medium-sized enterprises outside the financial sector. The response ratio was around one-third. See G M Bodnar and G Gebhardt, Derivatives Usage in Risk Management by U.S. and German Non-Financial Firms: A Comparative Survey, Centre for Financial Studies, Working Paper, 98/17, Frankfurt 1998.

on their liabilities – to hedge against interest rate risks. Portfolio managers can manage their portfolios' dependency on individual risk factors more quickly, more precisely and more cost-effectively than would be possible by means of adjusting their securities portfolios.

... and a macroeconomic perspective

Derivatives complete the financial markets by making risk factors tradeable. From a macroeconomic perspective, tradeability, in turn, is a precondition for the efficient allocation of risks. For that reason, derivatives are likely, in principle, to contribute to a higher rate of growth, even though the importance of that fact is difficult to quantify. This fundamentally positive impact, however, should not obscure our view of the risks that may arise from the use of derivatives. This point will be dealt with in greater depth towards the end of this article.

The market for interest rate derivatives

Early derivatives markets

The existence of derivatives markets has been recorded since early modern times.[5] As early as the 17th century, shares were sold and bought at a forward date and even share options were traded.[6] Trading of forward contracts on rice is also recorded in Japan in the 17th and 18th centuries. The basic features of modern derivatives exchanges emerged during the second half of the 19th century on the Chicago commodities exchanges. That was where quantities and prices were standardised for the first time, margin calls were regulated and the possibility of fulfilling contracts by means of offsetting trades rather than delivering the underlying was introduced. With rare exceptions, the majority of the early derivatives involved commodities contracts. Financial derivatives, which nowadays account for most of all forward transactions, did not make a breakthrough until the 1970s.

Following tentative beginnings in the 1960s ...

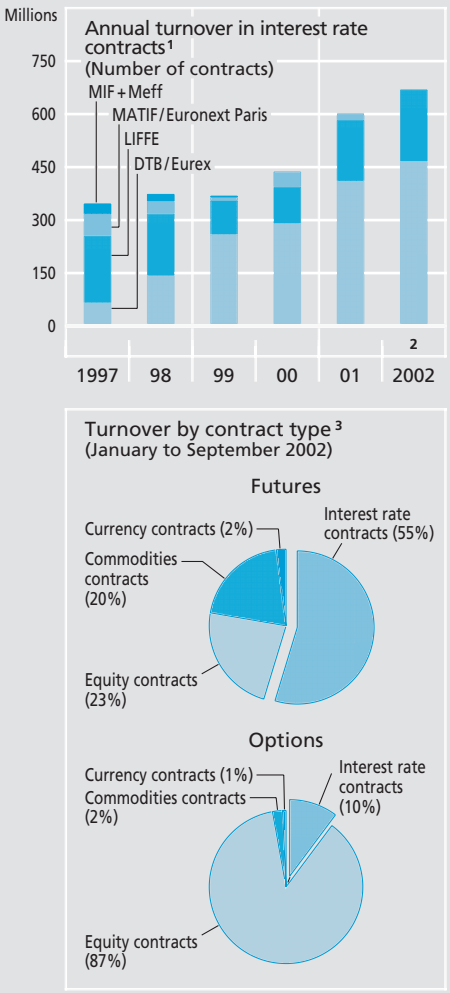
Although the first currency swaps appeared as early as the 1960s, they were used mainly to circumvent British capital controls and were thus of minor importance at first, especially as a world monetary system in which exchange rates were fixed meant that there was a limited need to hedge against exchange rate fluctuations. This situation only changed when the Bretton Woods system was replaced by free exchange rates in the early 1970s, leading to a sudden sharp increase in the demand for hedging instruments. That is the background to the success of the first exchange-traded currency future, which was introduced on the International Money Market of the Chicago Mercantile Exchange (CME) in 1972. Interest rate futures were first traded on the Chicago Board of Trade (CBoT) trading floor in October 1975 and were based on US mortgage bonds. In the end, these contracts gained no more than minor importance, mainly on account of the low level of standardisation in the potential underlyings. The futures (which were introduced shortly afterwards) on three-month CME Treasury Bills and long-term CBoT Treas-

... breakthrough of financial derivatives in the 1970s

5 There may have been futures contracts as long ago as antiquity. On the history of derivatives, see D Duffie, Futures Markets, Prentice-Hall, 1989 and F Allen and D Gale, Financial Innovation and Risk Sharing, MIT Press, 1994.

6 See Joseph de la Vega, Confusiòn des Confusiones, 1688, translated by H. Kellenbenz, No 12 (1987), The Kress Library Series of Publications, Harvard University.

Futures exchanges in Europe



1 Source: Deutsche Börse AG. — **2** Extrapolated on the basis of figures for January to October. — **3** Source: BIS.

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ury Bonds enjoyed greater success, benefiting from the dramatically increased interest rate volatility towards the end of the decade. It was in this setting that, in the early 1980s, the basic idea of currency swaps (which had now clearly gained in significance) was also transferred to the field of interest rates. Instead of payments in different currencies, the counterparties swapped interest payments on a given principal amount – mainly fixed payments for payments linked to a short-term interest rate.

Options

Even though options had been known for centuries, the role they played was a marginal one until the 1970s. This was due, in particular, to difficulties in terms of valuation which made trading with options a risky undertaking. A crucial boost was given to the option markets by the development of the Black-Scholes model, which – despite its restrictive assumptions – is nowadays still the basis for the valuation of options. In 1973, the year in which the groundbreaking article by Black and Scholes was published,[7] options on individual shares were introduced on the Chicago Board Option Exchange (CBOE). Index and interest rate options followed ten years later.

European futures exchanges

In Europe, it was only in the 1980s that the market for derivatives gained a firm foothold. Milestones in this respect were the establishment of the British derivatives exchange LIFFE in 1982, the French futures exchange MATIF in 1986 and the German Financial Futures Exchange DTB in 1989. In Germany, the establishment of a liquid futures market had been impeded, among other things, by existing legislation – a situation that was remedied only as part of the 1989 amendment of the Stock Exchange Act.[8] The comparatively late start of the DTB was one reason for interest rate

7 F Black and M Scholes, The Pricing of Options and Corporate Liabilities, *Journal of Political Economy*, Vol 81, 1973, pp 637-654.
8 The amendment of the Stock Exchange Act *(Börsengesetz)* included new provisions concerning the capacity to enter into forward contracts. Before 1989, forward contracts by private investors had been classified as gambling or betting, which meant that liabilities arising from them were void. The amended version of the Stock Exchange Act removed the legal basis for related difference pleas.

derivatives denominated in Deutsche Mark being traded, initially, mainly on the LIFFE in London. It was only during the 1990s that a large part of trading shifted to Frankfurt. This mostly concerned the long-term segment of the market, especially the future on ten-year Federal bonds (Bund future). By contrast, the LIFFE has been able to maintain its market position in money market contracts.

Exchange concentration in the euro area

European monetary union has brought a fundamental change to the European derivatives landscape. This has affected not only the foreign exchange field but also, in particular, interest rate derivatives. Following the elimination of the foreign exchange risk, the differences in yields among the individual participating countries have been reduced to a minimum.[9] A position in, say, Spanish bonds can now be hedged by a matching position in the Euro-Bund future, even though the latter is actually based on German Federal bonds. Although this hedging strategy is not entirely without risk – the price of the future and the price of the Spanish bond may still drift apart – that risk is generally offset by the higher liquidity of the Bund contract. European monetary union has thus been accompanied by a concentration of trading in euro-denominated bond contracts on the Eurex (the successor to DTB), while the LIFFE has strengthened its dominant position in the money market. Among the other national futures markets, only the French MATIF was initially able to defend its market share, while interest rate business activity on the Italian and Spanish derivatives exchanges (MIF and Meff, respectively) has virtually come to a standstill.[10]

Turnover and nominal values of exchange-traded derivatives

Between January and September 2002, 1.6 billion futures contracts and 1.7 billion options were traded worldwide on the futures exchanges. In the case of futures, 55 % of turnover was accounted for by interest rate derivatives,[11] followed by equity and commodities contracts at 23 % and 20 %, respectively. By contrast, foreign exchange futures were of very minor importance at 2 % of overall turnover. In the case of options, equity options were clearly to the fore at 87 % of turnover. Interest rate options were of no more than secondary importance with a market share of 10 %. At the end of September 2002, the nominal value of all open interest rate futures amounted to US$10 trillion, while that of interest rate options was as much as US$16 trillion.[12]

Organisation of futures exchanges

The growing popularity of futures exchanges when compared with the cash market may also be explained by the lower capital required. Price gains and losses are first offset on an internal exchange account. It is possible to sell the contracts short without – as on the

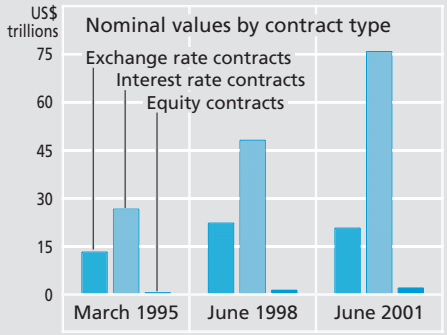
9 In the case of integrated markets, differing nominal rates of interest on government bonds denominated in the same currency can be explained mainly by differences in financial standing and liquidity from one country to another. See Deutsche Bundesbank, International integration of German securities markets, *Monthly Report,* December 2001.

10 For an analysis of the impact of European monetary union on the derivatives exchanges, see W Schulze and R Violi, Interactions between Cash and Derivatives Bond Markets: Some Evidence for the Euro Area, BIS Paper No 12.

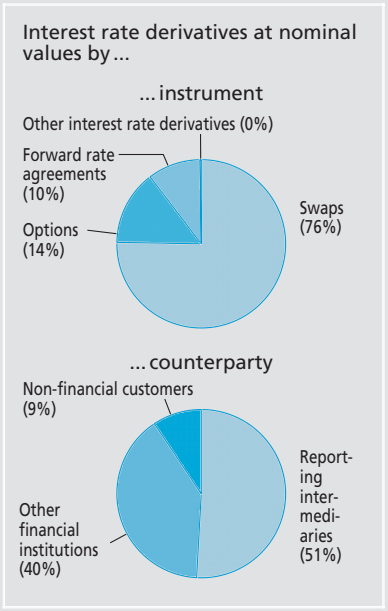
11 Measured by the number of contracts traded.

12 Source: *BIS Quarterly Review,* December 2002. It is not possible to make a direct comparison between the nominal values of interest rate derivatives and the nominal values of other contracts. At the end of September 2002, for example, the nominal value of all equity options and share index options was no more than US$1.8 trillion, despite the fact that turnover was much higher.

OTC derivatives trading



Position: end-June 2001



Source: BIS, based on central bank surveys of major derivatives traders (reporting intermediaries.)

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cash market – first having to borrow the matching paper. As a rule, open positions are closed by offsetting trades shortly prior to maturity and the account is squared; fulfilment of futures contracts by delivery of the underlying is the exception. Since interest rate futures are mostly based on a notional bond,[13] the delivered paper is converted into the underlying in accordance with a specified key. The conversion factor depends on the maturity and interest rate of the paper that is actually delivered and the extent to which they differ from the notional bond on which the contract is based.[14]

In contrast to the traditional cash exchanges, the market players on the futures exchanges conclude contracts with a central counterparty and not among themselves.[15] This has the advantage that transactions do not have to be unwound if one party does not fulfil its obligations. In order to hedge against that eventuality, the exchange demands a margin, which is adjusted to the market situation on a daily basis. If market players are unable to meet their resulting margin call, their positions are liquidated by offsetting trades.

Strong growth in OTC derivatives trading

The high degree of liquidity of listed derivatives is made possible by a large measure of standardisation of the contracts. Tailor-made instruments, on the other hand, are traded over the counter, as are those for which the margin system (for a variety of reasons) is impracticable. This last-named category includes swaps, for example, for which regularly recurring interest payments – but not principal amounts – are exchanged. In the past few years, the OTC market has witnessed even faster rates of growth than the futures exchanges. At the end of June 2001, the nom-

13 Futures on money market rates, which are based on a reference interest rate, such as the three-month Euribor, are an exception. These contracts are fulfilled exclusively by cash settlement.
14 The calculation of the conversion factor is described, for example, in M Steiner and C Bruns, *Wertpapiermanagement*, Schäffel Poeschel, 2000.
15 The Eurex-type model with a central counterparty and regulated margin calls is to be extended to the XETRA trading system this March. This means that the structure of the cash and futures markets will move into line with each other in this respect.

inal value of all open OTC interest rate contracts, at US$76 trillion, was more than four times higher than that of listed interest rate derivatives (US$17 trillion).[16] Interest rate swaps accounted for three-quarters of that amount, with 14 % being options and 10 % forward rate agreements.

Key role of investment banks as intermediaries

The vast majority of OTC derivatives transactions take place between internationally operating banks or other financial institutions. The market is very concentrated: just over half of all transactions in OTC interest rate derivatives takes place among some 60 institutions, of which seven are in Germany. In some areas, there are only a handful of players that account for the majority of turnover. Less than 10 % of OTC transactions in derivatives is conducted with end customers outside the financial sector. This stands in sharp contrast to conditions in the early 1980s, when swap transactions were conducted mainly between non-financial enterprises. At that time, the banks largely confined themselves to acting as brokers and did not themselves contract open positions. Under such circumstances, the users of derivatives often found it difficult to make a correct assessment of their counterparties' financial soundness. The market for OTC derivatives was therefore able to develop properly only when the banks increasingly began to act as intermediaries conducting transactions for their own account with the end customers.

Germany in third place

With 14 % of the overall transaction volume, Germany occupies third place in interest rate derivatives trading behind the United Kingdom (35 %) and the United States (17 %). Taking into account solely derivatives denominated in euro (just under half of the turnover in all interest rate contracts), German institutions have a market share of 22 %.

Impact on price formation and liquidity

Information leadership of the futures market

Owing to the low capital input and the possibility of selling short without major expenditure, derivatives are suitable not only as instruments for hedging against interest rate risks but also as a way of deliberately contracting speculative positions. A recently published Bundesbank research paper[17] on the price relationship between German Federal bonds and the Bund future shows that the vast majority of information is "priced in" on the futures market. In turbulent times, the processing of information takes place entirely on the futures market, in fact, and the prices for ten-year Federal bonds follow the future without contributing to price discovery. The highly liquid futures contracts, in particular, thus have a kind of price leadership over the underlying, the prices of which adjust to the prices on the futures market.

Derivatives and market liquidity

The impact of derivatives on the liquidity of the cash market is ambiguous. As a rule, market players can hedge more cost-effectively or contract speculative positions more easily by using derivatives than by investing in debt

16 See Bank for International Settlements, Triennial Central Bank Survey, Foreign Exchange and Derivatives Market Activity in 2001, March 2002, Table E.39.
17 C Upper and T Werner, Tail Wags Dog? Time-Varying Information Shares in the Bund Market, Discussion paper 24/02, Economic Research Centre of the Deutsche Bundesbank, October 2002.

securities. The futures market thus withdraws transactions from the cash market. The same applies to investors using futures for the purpose of acquiring bonds. Neither case necessarily results in the underlyings having a reduced market liquidity, however. This is because a futures market not only attracts transactions – it also creates new trading opportunities in the underlying securities. For example, traders in derivatives use the cash market to hedge against the risks arising from derivative transactions. Moreover, a category of securities may become more attractive overall if a liquid derivatives market is available for hedging. Thus, Federal securities owe their benchmark status on the euro-area bond market not least to the matching futures contracts having the function of major hedging instruments for long-term interest rate risks in the euro zone. According to one study, the market rewards the status of a bond as "cheapest to deliver",[18] ie as the actual underlying, in the case of the Bund future with a yield discount of just under three basis points.[19]

Liquid derivatives market is a precondition for benchmark function

Futures markets and price volatility

Operations that might otherwise be unprofitable may be conducted on the futures market since the transaction costs are lower. The effect of such transactions on price formation depends on the level of information of the players involved. Poorly informed investors who use capital investments like a lottery increase uncertainty and thus have a destabilising impact. However, investors of this type tend to make a loss in the long run and can therefore be displaced from the market.[20] Arbitrageurs can systematically generate a profit only if they buy at low prices and sell at high prices. Rational speculation therefore has a stabilising effect on the markets and thus tends to reduce volatility.

In addition to these basic considerations, derivatives have certain properties which may have a destabilising impact. It has been repeatedly observed, for example, that, shortly before a future matures, market players systematically buy up the underlying bond in order then to throw the hoarded paper on to the market at a profit. Unfortunately, it is not known whether this strategy met with success. What is certain, however, is that the resulting shortage of the underlying was only temporary and that there were no delivery problems upon the maturity of the futures contracts.[21]

Delta hedging and the impact of options

In contrast to futures, the payout structure of options is asymmetrical. Options thus provide investors with more extensive hedging opportunities than do pure forward contracts. For example, the holder of a call option on a bond cannot only hedge against price losses – ie an interest rate rise – but also benefit

18 Although several bonds are deliverable in the case of the Bund future, the fulfilment of the contractual obligations by means of a specific bond is generally cheaper than using the other paper. This bond is frequently described as "cheapest to deliver" or "ctd".
19 R Blanco, Euro Area Government Securities Markets: Recent Developments and Implications for Market Functioning, Bank for International Settlements, BIS Paper No 12, 2002.
20 However, there are some counter-examples in which uninformed players survive rational investors. See J B De Long, A Schleifer, L A Summes and R J Waldmann, Noise Trader Risk in Financial Markets, *Journal of Political Economy*, 98 (4), pp 703-738, 1990 and The Survival of Noise Traders in Financial Markets, Journal of Business, 64 (1), pp 1-19, 1991.
21 See W Schulte and R Violi, Interactions between Cash and Derivatives Bond Markets: Some Evidence for the Euro Area, BIS Paper No 12, 2002.

Derivative prices and delta hedging

In order to gain a better understanding of the price relationship between cash and futures markets and of delta hedging, it is useful first to recall some basic features of price formation in interest rate contracts and the valuation of interest rate options. Market players' arbitrage operations ensure a close parallel movement of prices in the cash and futures markets. Ignoring transaction costs, the price of a bond future F corresponds to the price of the underlying B plus the financing costs up to the maturity of the future: [1]

$$F = B\,(1 + r). \qquad (1)$$

If this condition is not met, arbitrage opportunities open up, the use of which drives prices towards their equilibrium values. If futures prices are too high, ie $F > B\,(1 + r)$, an investor might sell a future for, say, €F and buy a bond for €B. The investor first lends this as part of a repo at an interest rate r and then delivers it when the future matures. Futures prices which are too high (or bond prices which are too low) thus lead to selling on the futures market and to buying on the cash market. The opposite case of futures prices which are too low, ie $F < B\,(1 + r)$, also provides arbitrage opportunities, the use of which ultimately drives prices towards their equilibrium values. In this instance, the arbitrageur has to borrow bonds on the repo market and sell them immediately. At the same time, the arbitrageur buys futures and fulfils his obligations arising from the repo with the debt securities delivered when the futures contract matures. [2]

The valuation of interest rate options and the associated delta hedging are much more complicated than the replication of futures. We shall therefore describe them briefly using a simplified example. Let us assume that the price of a bond is currently €100 and may, in the next period, either rise to P_H = €110 or fall to P_L = €90. Let us now look at the case of a purchase option on the bond with a price of S = 100. The buyer of this derivative acquires the right to purchase the bond in the next period at a price of €100 – irrespective of how prices develop on the cash market. If the price of the bond rises to P_H = €110, the purchaser of the option makes a profit of €10. If bond prices fall, the option is worthless, however, and is not exercised.

For the option writer, a price rise on the cash market represents a risk which he can hedge against by purchasing bonds. The number of bonds needed for this is usually denoted by the Greek letter Δ, which is where the term "delta hedging" comes from. In the above example, the option writer therefore first buys bonds to the value of Δx€100. If there is a rise in price on the bond market, the value of the bond portfolio increases to Δx€110. This is matched by a payment obligation, arising from the sale of the option, amounting to OP_H=€10. Although, if the price falls, the option writer receives only Δx€90 from the sale of the bonds, he does not have to pay anything to the buyer of the option, ie $OP_L = 0$. The option writer can thus select Δ so that the value of the hedge portfolio, less the payments from the option, is independent of the future price of the bond. In the example, this would be the case if $\Delta x P_H - OP_H = \Delta x P_L - OP_L$. This implies a delta

$$\Delta = (OP_H - OP_L)/(P_H - P_L) = 10/20 = \tfrac{1}{2}.$$

The commonly used option price models are based on delta hedging. [3]

In practice, the hedge portfolio has to be adjusted continuously to current price developments. This can be explained by extending the above example. Let us assume that the price of the bond rises in the second period to €110 and, in the third period, can then either go up by another €10 to €120 or go back down to €100. The option payout would then amount to €20 or €0, which would correspond to $\Delta = 1$. The adjustment of the hedging portfolio over time is also called "dynamic hedging". The example shows that this involves a positive feedback between the price change of the underlying (bond) and the hedging operations. [4]

1 In practice, r is a rate for repo transactions. — **2** The arbitrage relationship between futures and bonds described here is a simplification. In practice, transaction costs are incurred and different bonds can be delivered which are converted using a conversion factor. For details, see H Diwald, *Zinsfutures und Zinsoptionen*, Munich, 1999. — **3** The hedge portfolio, consisting of a long position in a bond and a short position in the option, guarantees a secure payment in the next period. Its current price should therefore correspond to the price of a risk-free bond with an identical payoff. This means that the price of the option can then be determined. — **4** For a more detailed description of delta hedging in continuous time and the corresponding Black-Scholes model, see John C Hull: Options, Futures, and other Derivatives, Prentice-Hall, 1997.

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Derivatives and interest rate uncertainty on the bond market

The potential impact of derivatives on interest rate uncertainty on the bond market is studied below using the example of the Bund future. To do this, the yields of underlying Federal bonds are modelled using a GARCH(1.1) approach. A dummy variable in the regression for volatility provides information on the extent to which the introduction of the future contract on Federal bonds has affected interest rate uncertainty.

In the model regression, the yield outstanding on Federal bonds deliverable on the Eurex i_t is modelled as a first-order autoregressive process AR(1):

$$i_t = \beta_0 + \beta_1 i_{t-1} + \varepsilon_t.$$

The conditional variance of the disturbance item ε_t corresponds to the interest rate uncertainty. This is denoted as h_t and is modelled by the following variance equation:

$$h_t = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \alpha_2 h_{t-1} + \gamma_1 t + \gamma_2 d_t.$$

The introduction of the Bund future on the German Futures Exchange on 23 November 1990 [1] is characterised by a dummy variable d_t, which assumes the value of zero before that date and the value of one thereafter. A positive and statistically significant coefficient γ_2 then indicates an increase in volatility brought about by the future and a negative coefficient shows a reduction in interest rate uncertainty by the future. A time trend t was included in order to separate the impact of the derivatives market from other long-term effects on interest rate uncertainty. The GARCH model was estimated using daily data over the period from the start of 1978 to the end of 2001. The results are shown in the table below:

Parameter	Estimate	Significance level
Level equation		
β_0	$-8.2 * 10^{-4}$	0.74
β_1	1.0	0.00
Variance equation		
α_0	$3.18 * 10^{-5}$	0.00
α_1	0.06	0.00
α_2	0.93	0.00
γ_1	$1.61 * 10^{-6}$	0.73
γ_2	$-7.30 * 10^{-10}$	0.54

The estimation results show a high degree of persistency of the yield outstanding in both the level ($\beta_1 = 1$) and the volatility ($\alpha_1 + \alpha_2 = 0.99$). The parameters γ_1 and γ_2 are both extremely small and statistically insignificant. Thus, neither a trend movement in interest rate uncertainty nor an influence of the introduction of the Bund Future can be demonstrated. [2]

1 The results remain largely unchanged if the estimates are based on the introduction of the Bund Future on the LIFFE on 29 September 1988. — **2** It has been possible to show comparable results for the US market for Treasury bonds and the related futures contracts. See S P Hedge, The Impact of Futures Trading on the Spot Market for Treasury Bonds, *The Financial Review*, 29, pp 441-471, 1994.

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from price gains. On the other hand, in order not to enter into an incalculable risk, the issuer of the option has to adjust his portfolio continuously. This is referred to as "dynamic" or "delta" hedging (see explanatory notes on page 39). Such hedging operations can amplify price movements since underlyings are sold if prices are falling and purchased when prices are rising. They have a particularly destabilising impact if the exercise prices of options are concentrated on certain threshold values. The overshooting of such a threshold may then lead to a chain reaction, resulting in extreme price fluctuations. For the United States, it has been possible to show that such hedging operations may also distort the term structure of interest rates. [22]

Bund future and interest rate uncertainty

The question as to whether futures markets increase or reduce volatility is therefore an empirical one. An econometric study of the yield development of ten-year Federal bonds based on daily data for the period from 1978 to 2001 shows that the introduction of the Bund future had no demonstrable effect whatsoever on the volatility of German bond yields (see the adjacent explanatory notes). Independently of this, however, each investor has the possibility of using interest rate derivatives to change his individual interest rate risk.

22 See J Kambhu and P Mosser, The Effect of Interest Rate Options Hedging on Term-Structure Dynamics, *Economic Policy Review*, Federal Reserve Bank of New York, 2001.

Effects of the increasing use of derivatives

Monetary policy implications

1994 assessment largely confirmed

The above-mentioned *Monthly Report* article on the monetary policy implications of interest rate derivatives, which was published in 1994, came to the conclusion that the existence of derivatives does not affect the central bank's ability to influence interest rates on the money market. Changes in the scale and speed with which monetary policy measures impact on the real economy were conceivable, however. On the whole, however, monetary policymakers could, if anything, take a relaxed view of the increasing use of derivative instruments. From the current perspective, this assessment has been confirmed. It is only on isolated points that the conclusions drawn in 1994 have to be modified somewhat.

Changes in the monetary policy transmission process

Although the existence of interest rate derivatives does not reduce the central bank's ability to control short-term interest rates, the use of such instruments can lead to changes in the monetary transmission process. In this context, it is not possible, however, to separate the impact of derivatives from that of other changes in the structure of the financial system. For instance, the securitisation of large parts of the banks' balance sheets means that credit institutions are more dependent on interest rates – something which banks can, in turn, contain by the use of derivatives. In the final analysis, however, derivatives can only spread risks – not eliminate them. In every transaction, there is a counterparty which accepts the traded risk. This does not necessarily have to be a domestic bank. Risks may also be transferred to other institutions, say, to insurance companies, or to another country, which means that the transmission of monetary policy stimuli through the domestic banking sector will tend to become weaker.

Credit channel less important

Of the various monetary policy transmission channels, the credit channel – which is based on frictions in lending to enterprises – is likely to be especially affected by the use of derivatives. That is because derivatives enable firms to hedge against rising interest rates (and thus also against price losses in their loan collateral). For the transmission process, this means that the credit channel is becoming less effective.[23] However, in Germany and the euro area as a whole, the credit channel plays a secondary role to the interest rate channel in any case. A further weakening is therefore likely to be of very little relevance to monetary policy.

Derivatives as monetary policy instruments ...

With the exception of currency swap arrangements, no major central bank at present uses derivatives as an instrument of monetary policy. Nevertheless, the central bank could, in theory, use derivative contracts (such as forward rate agreements or options) to influence longer-term interest rates. However tempting it might seem to use derivatives for that purpose, such operations would be fraught with enormous risks. It would mean the central bank tying its own hands and committing it-

23 See I Fender, Corporate Hedging: The Impact of Financial Derivatives on the Broad Credit Channel of Monetary Policy, BIS Working Paper No 94, November 2000.

self over an extended period to a given interest rate path, which would be very costly to leave. In particular, adopting such a strategy would make it all but impossible to respond appropriately to future shocks. For that reason, interest rate derivatives have no place in the set of monetary policy instruments. It is only in extreme situations – such as in a persistent deflation – that a central bank might find it useful to be able to commit itself to a specific interest rate path by using derivatives.[24]

... and indicators

Even though derivatives are hardly suited to be monetary policy instruments, the heightened information efficiency of the market associated with them can be used for monetary policy purposes. Derivatives prices provide many different kinds of data about market players' expectations. This information enables the central bank to form a more nuanced judgement of the impact of monetary policy measures.[25] As information is "priced in" mainly on the futures market, futures are fundamentally better indicators than are bonds. The close arbitrage relationship between the cash and futures markets ensures that identical information can be observed in both market segments after only a few minutes.[26] In monetary policy practice, it is therefore irrelevant which market is being analysed.

Stability of the financial system

Concentration of OTC derivatives trading

Potential risks to the stability of the financial system are primarily associated with OTC derivatives trading since it is concentrated on a comparatively small number of intermediaries with a diverse presence in the various market segments. As things stand at present, there are no empirically corroborated findings on the impact that the sudden collapse of a major market maker can have on financial system stability. There are indications, however, that the derivatives markets are sufficiently liquid to allow the unwinding of sizeable positions without causing major dislocations. More problematical than the collapse of individual institutions, however, is a critical situation that affects several institutions at once. The events of September and October 1998 show that, under such circumstances, the limits of the markets' resilience may soon be reached.[27]

Lack of transparency in OTC activity ...

In addition to its high degree of concentration, the lack of transparency on the OTC derivatives market gives cause for concern. The accounting of many market players has not kept pace with innovation on the financial markets. In Germany, derivatives, as a rule, are shown on the balance sheet only upon their maturity. Before that they are deemed to be uncompleted transactions, which do not appear on the balance sheet and are mentioned, if at all, only in the notes on the annual accounts. In other countries, banks

24 See P A Tinsley, Short Rate Expectations, Term Premiums, and the Central Bank Use of Derivatives to Reduce Policy Uncertainty, Finance and Economics Discussion Paper 1999-14, Federal Reserve Board, Washington DC, 1999.
25 See Deutsche Bundesbank, The information content of derivatives for monetary policy, *Monthly Report*, November 1995.
26 See C Upper and T Werner, How Resilient Are Financial Markets to Stress? Bund Futures and Bonds During the 1998 Turbulence, Bank for International Settlements, BIS Papers No 12, 2002.
27 See Deutsche Bundesbank, The impact of financial market crises on the German securities markets, *Monthly Report*, April 2000.

can show their derivatives activities on the balance sheet, but the associated information value is limited by the considerable scope for discretion that is available and by rights to opt for an alternative procedure.[28] A further difficulty in the accounting of OTC derivatives is the lack of an observable market price at which open positions can be valued. While there are recognised pricing models for "plain vanilla" products, such as simple swaps or options, the valuation of complex derivatives is often hard to follow. For the reasons cited, it is difficult for outsiders to assess the financial situation of the major players in the derivatives markets.

... and complicated valuation ...

... make it difficult to assess counterparty risks

The sometimes very high degree of complexity of OTC derivatives makes considerable demands on the market players. With newly introduced instruments, in particular, there is no guarantee that their risk profiles are really always properly understood. For example, owing to errors, a number of major multinational companies have suffered significant losses when using derivatives.[29]

Considerable demands on market players

The German banking supervisors reacted at an early stage to the increasing use of derivatives. Credit institutions have had to include derivatives in their reports to the Bundesbank since as long ago as 1986. Since October 1990, open positions in derivatives have had to be backed by capital.[30] Derivatives are not treated fundamentally differently from other financial assets. In the case of interest rate derivatives, this is of particular relevance to the capital requirements for market risks, which, since 1996, have applied to the bank's portfolio as a whole. This means that the market price risks of derivatives positions and the price risks of securities can be offset against each other if they run in different directions. The use of derivatives for hedging purposes thus lowers the prudential capital requirements, while the incurrence of additional risks through derivatives increases them.

Consequences for banking supervision

Closing remarks

The financial system has become far more complex over the past few decades. The growing number of financial instruments means that it is possible to split up risks into ever finer individual factors and trade them. The increased use of derivatives is a key feature of this development. This may produce changes in the monetary policy transmission process, although such changes have thus far stayed within narrow and manageable bounds. Overall, from the perspective of the monetary policymakers, this is likely to be outweighed by the information advantages. Less easy to predict, by contrast, are the risks to the stability of the financial system resulting from transactions being concentrated on a small number of banks, insurance companies and securities firms active in OTC de-

28 See L Schirmer, *Die Rechnungslegung von Finanzderivaten bei Banken in Deutschland, Japan und USA*, Deutscher Universitätsverlag, 2000; regulations on the accounting and valuation of financial derivatives may be found in, for example, IAS 39 of the International Accounting Standards Board and in the US Financial Accounting Standard (FAS) 133.

29 A short list of these may be found in G J Schinasi, R S Craig, B Drees and C Kramer, Modern Banking and OTC Derivatives Markets, International Monetary Fund, Occasional Paper 203, 2000, p 28.

30 See Deutsche Bundesbank, Off-balance-sheet activities of German banks, *Monthly Report*, October 1993.

rivatives trading. Much the same applies to the lack of transparency in such trading. Clear, internationally harmonised accounting standards are needed so that the players can make a better assessment of their counterparty risks. The accounting of derivatives at their "fair value" in accordance with IAS 39 is a step in that direction. In the interests of greater transparency and valuation certainty, the available scope for discretion and rights to opt for an alternative procedure in the accounting of derivatives should be reduced to an absolute minimum.