Derivatives and their feedback effects on the spot markets

Derivatives are the fastest-growing, most dynamic segment of the modern financial markets. They complement spot market instruments and create new opportunities for the transfer of risk among market participants. Derivatives trading is contributing increasingly to price discovery on financial markets.

On the other hand, derivative instruments can also give rise to additional risks, such as counterparty risk and risks to financial market stability. The present report focuses on the latter, with regard to the potential feedback effects of derivatives markets on the underlying spot markets. One example of such feedback is if derivatives are replicated or hedged by buying and selling the underlying asset on the spot market. This can amplify price fluctuations through pro-cyclical purchases and sales of the underlying asset on the spot market.

Robust market structures are a primary method of avoiding destabilising effects. Moreover, regulatory measures such as price ranges or trading halts can help to defuse crisis situations.

Spectrum of derivatives

Derivatives include financial products such as options, forward rate agreements, futures, certificates and swaps. The market value of such derivative instruments can be derived from the movement of the value of the

underlying asset (eg bonds, stocks, commodities) on which they are based.

Derivatives are traded either in a standardised form (eg exchange-traded futures) or directly between the contractual parties, ie "over the counter" (OTC). The most important exchanges for organised derivatives trading worldwide are the German-Swiss futures and options exchange EUREX, the UK's International Financial Futures Exchange (LIFFE), and the US financial and commodities exchanges Chicago Board of Trade (CBOT) and Chicago Mercantile Exchange (CME).

Potential incentives for derivatives trading include deriving disproportionate benefit from the price movement of the underlying asset for just a relatively small capital input or profiting from falling prices. On the other hand, derivatives are also used to hedge against fluctuations in the price of the underlying asset.

How the market for derivatives has evolved

Trade in derivatives has increased sharply in the past two decades. It was initially focused on equities and commodities markets; the strategies tested in those markets were subsequently also applied to interest rate risk and exchange rates. Credit derivatives, with which credit risk can be decoupled from the underlying credit transaction and traded separately or created from scratch, are a relatively new segment.

According to figures from the Bank for International Settlements (BIS), the nominal value of all OTC derivatives contracts outstanding worldwide (excluding credit derivatives) has roughly tripled between 2000 and 2005, from US$95 trillion to US$285 trillion. In itself, the nominal contract volume is not very meaningful, as the risk incurred by market players is measured in terms of their net positions, which make up a small percentage of the aggregate contract volume. However, the trend in the total outstanding contract volume provides an impression of the rapid dynamics of the market for derivatives. Broken down by individual instruments, around 71% of outstanding derivatives are swaps, 16% are options and 13% are forward and futures contracts.

Swaps as an exchange of payment obligations

A swap is a contractual agreement to exchange, or swap, assets or payment obligations. Foreign exchange swaps, therefore, are the simultaneous spot sale and forward purchase of foreign currency or the simultaneous spot purchase and forward sale of foreign currency. The most important category of swaps is the interest rate swap, which is the exchange of fixed and variable-rate interest payments based on a (notional) principal. This way, for instance, differences in financing conditions can be used to exploit cost advantages.

Conditional nature of options

By buying an option, the buyer acquires the right to buy or sell a certain amount of an asset (the underlying asset) on a future date at an agreed price. An option is conditional in that the buyer acquires the right, but not the obligation, to exercise the option later.

Unconditional nature of futures

By contrast, futures are "unconditional" transactions in that the delivery of a precisely determined underlying asset is agreed at a specific future date and a price already set

upon the conclusion of the contract. Unlike forward rate agreements, all features of a futures contract are standardised for exchange trading. This paves the way for transparent trading, low trading costs and simplified market access.

Futures markets enable the transfer of risk between different market partners which is born, for instance, of the need to hedge against the spot price risks. By taking a futures position, the buyer freezes the price at which he can buy the underlying asset later on and the writer freezes the price at which he will deliver the underlying asset. However, futures contracts are generally not fulfilled via physical delivery of the underlying asset; instead, the difference between the agreed futures price and the market value of the underlying asset is settled in cash. The profits and losses resulting from the futures position are settled through a clearing intermediary daily. To cover payment obligations, the clearing point requires collateral payments (margin requirements). If the fulfilment of a derivatives contract is not linked to the delivery of the underlying asset, the trade volume can be expanded virtually *ad infinitum*.

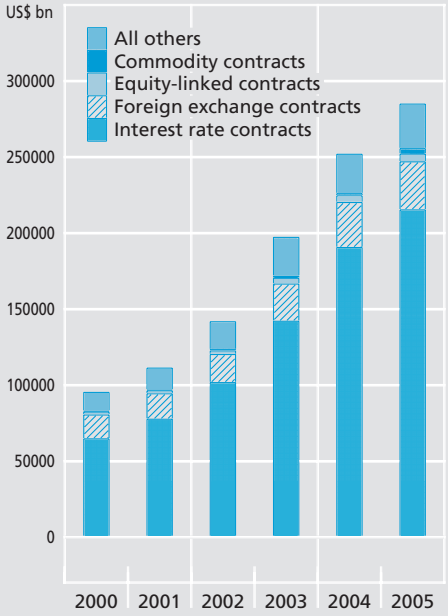
Financial derivatives in perfect and complete markets

In perfect markets ...

The perfect markets concept, which is a fundamental element of finance theory, may be used as a point of departure for analysing the link between derivatives and the underlying spot values. In perfect markets, all market players act rationally and share the same information, ie new information is factored into the prices of financial instruments immediately (also known as information efficiency). Moreover, financial instruments can be traded without transaction costs. On balance, there is no arbitrage: future payment flows are factored into each instrument equally – irrespective of whether they are traded at different exchanges or of differences in the packaging of claims and obligations. In a perfect market, this should thus make it impossible to obtain a risk-free profit by simultaneously buying a financial asset "low" and selling it "high"; price movements on the derivatives and spot markets for their underlying assets should be simultaneous. Moreover, in a perfect market, all the desired possible payment flows can be replicated from a combination of the traded instruments.

Global amounts outstanding of OTC derivatives

Year-end data



Source: BIS.

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... derivatives have no impact on spot markets

In this reference framework, derivates markets have no impact on spot markets. Instead, the value of a derivative can be "derived" explicitly from the value of the underlying asset. In the real world, however, financial market frictions – such as transaction costs, trade restrictions, fragmented markets and illiquidity – mean that derivatives markets could well have feedback effects on spot markets. The conditions under which this could happen, and the potential consequences, will be illustrated below.

Derivatives trading given market frictions

Why derivatives are traded

In order to implement their strategies, investors can generally use both the spot and derivatives markets. Their choice of market usually depends on a number of factors. If transaction costs and financing restrictions exist, market players may have an incentive to trade in options instead of the underlying asset in order to capitalise on leverage and relatively low transaction costs.[1]

Derivatives make portfolio shifts much easier

It is often easier to implement more complex strategies in derivatives markets, in which liquidity is ample, market access is simple and instruments are quickly tradable. If, for instance, a highly diversified portfolio of stocks is to be shifted to bonds, this can be accomplished by selling stocks and buying bonds. It may be easier, however, to sell a future on a stock index which replicates the stocks in the portfolio. The stock risk is reduced by selling a future since gains on stocks are offset by losses from the sale of the future and losses on stocks by gains from the futures position. If the index future exactly replicates the stocks held in the portfolio, the stock position is said to be completely hedged. The joint futures and equity position is thus risk-free, and therefore equivalent to a bond of similar maturity.

Market players, therefore, can trade the future in one single transaction instead of dealing several individual stocks. This saves transaction costs and focuses liquidity on the future. Stock indices are weighted averages of the prices of various stocks that are not traded at the exact same time. The index future, however, could be interpreted as an approximation of the notional value of the stock index if all the stocks contained in the index were traded simultaneously.

How derivatives markets affect price discovery

Price discovery for stock indices and stock index futures ...

Against this background, the question now is the extent to which derivatives markets affect price discovery on the spot markets. Empirical evidence on stock markets indicates that the prices of stock index futures often lead the underlying stock indices. The lead is frequently five minutes or more.[2] Grunbichler et al (1994) find, for the German stock index

1 See F Black (1975), Fact and fantasy in use of options, Financial Analysts Journal 31, pp 36-41 and 61-72, and S Mayhew, A Sarin and K Shastri (1995), The allocation of informed trading across related markets: An analysis of the impact of changes in equity-option margin requirements, *Journal of Finance,* 505, pp 1635-1654.
2 See *inter alia* L Harris (1989), S&P 500 cash stock price volatilities, *Journal of Finance,* 46, pp 1155-1175 or H R Stoll and R E Whaley (1990), The dynamics of stock index and stock index futures returns, *Journal of Quantitative Financial Analysis,* 25, pp 441-468.

(DAX), that the DAX index futures price leads the DAX index by 15 to 20 minutes.[3] One explanation is that new information enters into the stock index only through the trading of individual stocks. However, owing to transaction costs, it is not possible for all stock prices to adjust immediately and simultaneously to new market information. This means that, in the derivatives market, even though the law of one price is generally valid, information of relevance to the market could be factored in more quickly – at least whenever the arbitrage bands defined by the differences in transactions and opportunity costs are not violated.

In an independent study on the co-movement of the DAX and the DAX future, an approach to determine the share of information from the DAX and the DAX future in price discovery was chosen instead of the "lead-lag approach", in which the chronological order of price formation is estimated and measured in units of time. The prices of both instruments at five-minute intervals from 20 April to 26 June 2006 were used for this study. For the approximately 4,680 observations, a vector error correction model which replicates both the long-run price equilibrium between the DAX and the DAX future and the short-run dynamics of the prices when they deviate from this equilibrium was estimated. This model can be used to estimate to what extent the DAX price follows a change in the DAX futures price or vice versa. The coefficient of the estimation model can be used to derive the Granger and Gonzalo (GG) measure, which quantifies the share of information from the DAX and the DAX futures in price discovery.[4] The GG measure indicates that the DAX futures index leads the DAX index.

... and in the credit markets

There is also empirical evidence that derivatives markets prices lead those of bond markets. The highly liquid Bund future, for instance, makes a much greater contribution to the price formation process than the underlying German government bonds.[5] Moreover, in many markets credit derivatives prices have begun to lead those of bond markets.[6] Credit derivatives can be used to hedge against credit risks or to exploit changes in credit risks. They enable credit risks to be traded individually at low transaction costs and without any major restrictions. Many market players therefore take recourse to the liquid segments of the credit derivatives market to implement their strategies quickly.

The results, admittedly, are not consistent with the above-postulated law of one price for derivatives and spot markets: more precisely, the spot markets for financial claims are no less forward-looking than their derivatives markets. Even if derivatives markets are assumed to have a certain lead, given the long time lag before real supply responds, the

3 See A Grunbichler, F A Longstar and E S Schwartz (1994), Electronic screen trading and the transmission of information: An empirical examination, *Journal of Financial Intermediation,* 3, pp 166-187.
4 For a derivation of the GG measure, see J Gonzalo and C Granger (1995), Estimation of common long-memory components in cointegrated systems, *Journal of Business and Economic Statistics,* 13, pp 27-35.
5 See C Upper and T Werner (2002), Tail wags dog? Time-varying information shares in the Bund market, Deutsche Bundesbank, Discussion paper 24/02.
6 See also H Zhu (2004), An empirical comparison of credit spreads between the bond market and the credit default swap market, BIS Working Paper No 160 and Deutsche Bundesbank, Credit Default Swaps – functions, importance and information content, *Monthly Report,* December 2004, pp 43-56.

relevance of the derivatives markets' price lead is likely to be limited.

Do derivatives influence the stability of the spot markets?

Other approaches in the finance literature examine the effects of the introduction of futures and options on the volatility of spot market prices.

The relevance of volatility considerations

Among other things, the question of the potential impact of derivatives on spot market volatility is relevant with regard to financial stability. To be sure, volatility is not negative for financial markets *per se*. In fact, fundamentally justified volatility reflects the processing of information in the financial markets and, thus, is a precondition for efficient price discovery. However, from an investor's point of view, volatility is an approximation of the prevailing uncertainty in the market and – at least in falling markets – is perceived as generating stress. This is all the more so as diversification of assets often affords little or no protection against strong and market-wide price changes. In extreme cases, this may result in liquidity and solvency problems and ultimately in a disruption of various functions in the financial system – examples being payment settlement, risk valuation and risk transfer, as well as liquidity allocation.

Derivatives' effects on volatility

Analyses of the volatility effects of derivatives markets are often linked to the question of how much spot market volatility is affected by speculative trading.[7] Friedman (1953) noted that market players willing to take risks would, in the long run, ultimately contribute to smoothing prices. Market players with false expectations who increase price volatility by selling "low" and buying "high", by contrast, would eventually be doomed to failure and disappear from the market.[8] However, Friedman's argument, which seems intuitively reasonable, was refuted by the emergence of successful trend-following strategies.[9]

Stabilising effects on commodities markets?

In many of the models discussed in the finance literature, derivatives markets can have a stabilising effect on the relevant spot markets. Peck (1976) shows that futures can stabilise commodities prices if production and storage decisions are made based on the futures price.[10] Rising prices in the forward-looking futures markets could then provide an incentive to increase production and storage and thus contribute to preventing supply bottlenecks in the future. This will tend to smooth price movements. Depending on the parameter values, the results produced by the individual models, however, can generally be equally stabilising or destabilising.

What the empirical evidence does indicate, though, is that, if derivatives are introduced, spot market volatility either falls or at least

7 For an overview of the literature, see S Mayhew (2000), "The impact of derivatives on cash markets: What have we learned?", Working Paper, University of Georgia, Department of Banking and Finance.
8 See M Friedman (1953), The case for flexible exchange rates, Essays in Positive Economics, Chicago University Press, p 175.
9 The first to formulate this was W J Baumol (1957), Speculation, profitability, and stability, *Review of Economics and Statistics,* 39, pp 263-271.
10 See A E Peck (1976), "Futures markets, supply response, and price stability", *Quarterly Journal of Economics,* 90, pp 407-423.

does not increase any further, and that spot markets tend to become more liquid.[11]

How hedging strategies influence derivatives markets' impact on spot markets

The discussion about the link between derivatives markets and spot markets has thus far centred on the distribution and processing of information by market players. There has been no discussion of information-free trading, ie transactions not induced by new information or market expectations, such as the impact that occurs when option writers insure themselves against losses from their open options positions by spot-buying and spot-selling the underlying asset, or if options are replicated by spot-market transactions.[12]

Option valuation ...

The approach used to replicate options is derived from the results obtained by Black and Scholes, who demonstrated that standard call and put options can be priced through replication by a portfolio composed of the underlying asset and a loan or an investment at the risk-free rate of interest.[13] However, this portfolio must continuously be adapted to current market conditions. The "delta" of the option can be used to determine the quantity of the underlying asset to be called or put, which is why one also speaks of dynamic hedging or delta hedging.[14]

... and dynamic hedging

The traditional derivation of option values using the Black-Scholes formula rests on the assumption of efficient markets, which postulates that the replication of options has no effect on the price of the underlying asset. The trade in the underlying asset induced by dynamic hedging, however, can certainly affect spot-market prices, especially owing to liquidity constraints.

Dynamic hedging requires large amount of liquidity ...

Spot markets are not always liquid enough to permit dynamic hedging; therefore, recourse is normally taken to other derivative instruments, specifically futures. Another advantage of futures is that they can replicate indices and make it easy to obtain insurance against a broad range of market risks. The standardised nature of derivatives market contracts promotes liquidity. The term standardisation indicates that a group of market participants with varying motives for transactions uses a relatively narrow set of instruments; as a result, liquidity is not nearly as fragmented as in the spot markets. High liquidity also reduces the market's price sensitivity when settling large transaction volumes and, in turn, reduces the severity of price fluctuation.

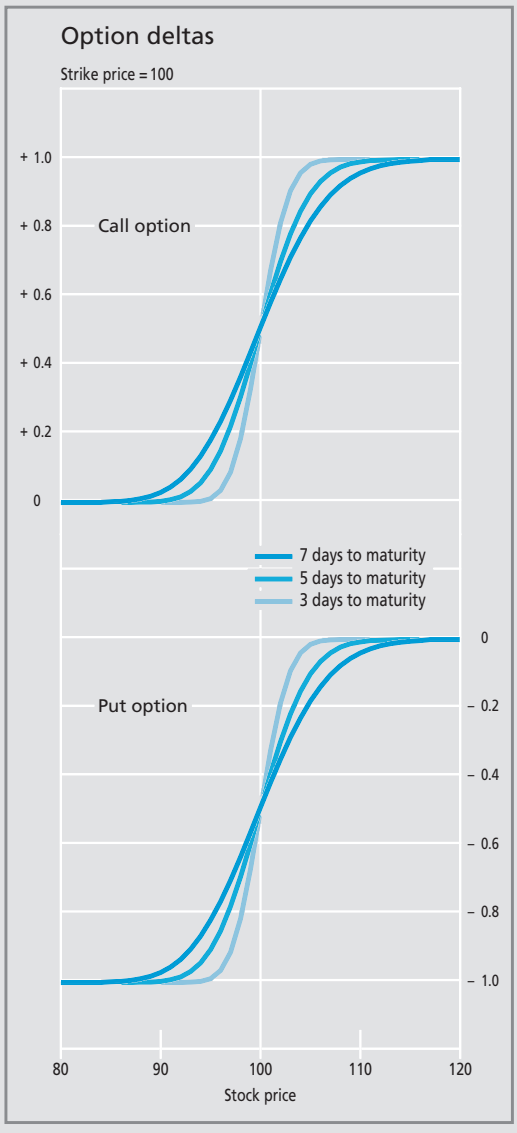
... and affects price dynamics

If many market players are pursuing dynamic (pro-cyclical) hedging strategies, this can have a destabilising effect on the markets for hedging instruments. A dynamic hedging strategy requires constant buying and selling of the

11 For a more detailed discussion of the literature see S Mayhew (2000).
12 Leland postulates that investors can resort to manufacturing synthetic puts through spot-market transactions to insure their portfolios if a suitable number of actual puts was not available. See H E Leland (1980), "Who should buy portfolio insurance?", *Journal of Finance,* 25, pp 581-596.
13 See F Black and M Scholes (1973), The pricing of options and corporate liabilities, *Journal of Political Economy,* 81, pp 637-654.
14 Delta hedging is the fundamental concept. Other possibilities include gamma hedging (in which the delta itself is held constant) or vega hedging (in which volatility is held constant).

The option delta and delta hedging

The option delta denotes the sensitivity of the option's theoretical value to a one unit change in the price of the underlying asset, where all other variables are constant. Whereas call option deltas are positive, put option deltas are negative.



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Call option: where the spot price of the underlying asset is far below the strike price (deep-out-of-the-money call), the delta is 0, ie stock price movements have no impact on the value of the option since the option will not be exercised and will expire worthless. Where the spot price is far above the strike price (deep-in-the-money call), the delta is 1, ie the change in the option's value corresponds to the (absolute) change in the stock price. Where the spot price is close to the strike price (at-the-money call), the delta will rise with the spot price. The delta increases more rapidly as the expiration date approaches.

Put option: where the spot price of the underlying asset is far below the strike price (deep-in-the-money put), the delta is -1, ie the put option's value falls (increases) by the same amount as the increase (fall) in market prices. Where the spot price is far above the strike price (deep-out-of-the-money put), the delta is 0, ie stock market movements have no impact on the value of the option since the option will not be exercised and will expire worthless. Where the spot price is close to the strike price (at-the-money put), the delta will rise with the spot price.

For example: if the delta of a call option on a stock is 0.8, this means that a slight change in the stock price will cause the price of the call option to change by 80% of that amount. In other words, the delta indicates the number of stocks required in a portfolio to replicate the option or to hedge against changes in its value. Since an option's delta fluctuates constantly during its term, continual adjustments have to be made to the replicated portfolio by buying and selling stocks. This is known as delta hedging.

underlying asset and contributes to a correspondingly high trade volume in the markets for hedge instruments. The underlying asset must be bought in times of "rising markets" and sold in times of "falling markets".

Hedging strategies and the 1987 stock market crash

Strategies to hedge against falling stock prices were already blamed for amplifying the falling price trend in the case of the 1987 stock market crash.[15] The Brady Commission appointed to investigate the cause of the crash emphasised that a wave of institutional sales induced by portfolio insurance strategies accelerated the decline.[16] The Commission stated that the illusion persisted among market participants that there was sufficient liquidity in the stock markets to absorb the hedging sales without major price volatility.

"Uninformed" market players can amplify feedback effects

This view held by market players was consistent with many traditional models founded on the belief that the trading volume induced by hedging strategies was too small to cause noticeable disruptions to the spot markets. Following the 1987 stock market crash, however, more and more models seeking to explain the phenomenon of hedging-induced stock price slides were developed. Whereas Brennan and Schwartz (1989), using a model with a (consumption) utility-maximising investor, forecast only a slight impact of portfolio insurance strategies on capital market prices and volatility,[17] Gennotte and Leland (1990) show that, for example, information asymmetry between market players can lead to relatively illiquid markets.[18] In their model, some market players align their investment behaviour to financial market price movements instead of to the fundamentals. They take falling prices as a signal to sell irrespective of whether the price movement was triggered by fundamentally justified changes in expectations, liquidity shortfalls or hedging strategies. Gennotte and Leland refer to the market crash of October 1987, in which, according to them, nearly 15% of the turnover in stocks and stock index futures were induced by portfolio insurance strategies, and then show that an unobserved supply shock, in conjunction with dynamic hedging, can cause stock prices to fall relatively sharply. According to Gennotte and Leland, when the market crashed in 1929 the unobserved hedging plans consisted exclusively of stop-loss strategies, whereas in 1987 portfolio insurance (through dynamic hedging) became an additional, and major, contributing factor to the price slide.

Volume of orders could no longer be handled

The large volumes of orders that were flooding the market in October 1987 were also a reflection of traders' willingness to trade in large positions, which was fostered by low transaction costs. In addition, index futures, which had just been introduced in 1982, made it easy to carry out dynamic hedging strategies. The market makers were not sufficiently capitalised to provide adequate liquidity and manage the increased volume of orders.

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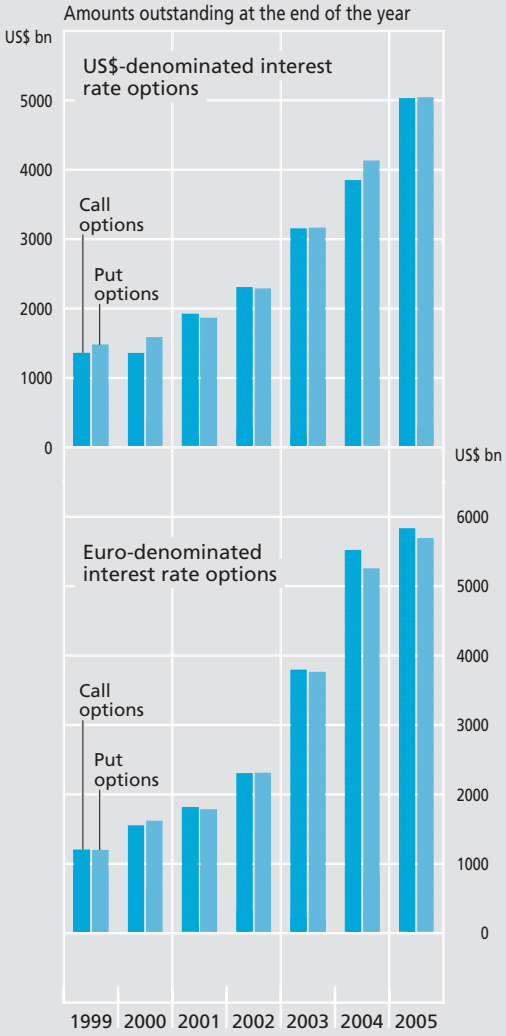
15 On 19 October 1987 – called "Black Monday" – stock prices around the world went into a free fall. That day, the US Dow Jones stock index fell by 22.6%.
16 See N F Brady et al (1988), Report of the Presidential Task Force on Market Mechanisms, Washington, US Government Printing Office.
17 See M J Brennan and E S Schwartz (1989), Portfolio insurance and financial market equilibrium, *Journal of Business,* 62, October, pp 455-476.
18 See G Gennotte and H Leland (1990), Market liquidity, hedging, and crashes, *The American Economic Review,* Vol 80, No 5, December.

Interest rate options positions of options dealers

Amounts outstanding at the end of the year



Source: BIS.

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Measures to contain price disruptions

These experiences showed the need for measures to strengthen market structures so that, in the future, sudden disruptions in the stock markets could be prevented. Against this background, ideas such as the merger of clearing houses, price ranges to curb extreme volatility and "circuit breakers" to head off the threat of market disruptions, as well as changes in margin requirements, have all been discussed.[19]

Margin requirements

Margins denote collateral requested by clearing houses or by brokers on behalf of trading parties entering into a futures contract. The cash payment serves as collateral for the traders' obligations from the futures contract. Following the initial margin payment upon concluding the contract, additional margin payments (margin calls) may become necessary if the investor's position is losing money on the transaction. The futures markets can be used to illustrate the impact of margin requirements.[20] The amount of the margin requirements for the futures contracts has an impact on market liquidity. Small margin payments mean less of a need for capital in order to enter into and maintain a futures position and thus enhance liquidity.

In times of high volatility, however, there is the danger that the margin payments made will not suffice to offset the volatility and that investors could be forced either to make additional payments or to close out their futures positions. In that case, large volumes of orders from one side of the market (buyers or writers) would flood the market. Low margin requirements, which would promote liquidity in times of low volatility, would have the opposite effect – to dry out the market through a bias of either call or put orders – in times of high volatility.

Where futures positions are completely hedged, by contrast, margin requirements are completely superfluous. If, for instance, an in-

19 For a detailed overview of regulatory measures see N F Brady et al (1988).

20 See M Rubinstein (1988), Portfolio insurance and the market crash, *Financial Analysts Journal*, Jan-Feb, pp 38-47.

vestor is holding a highly diversified stock portfolio and, at the same time, sells an index future that replicates his stock portfolio, the stocks can serve as collateral for the margin payments from the futures contract. During the 1987 crash, hedged market players also created additional selling pressure as they had to liquidate their stocks in order to meet the margin requirements.

Trading rules

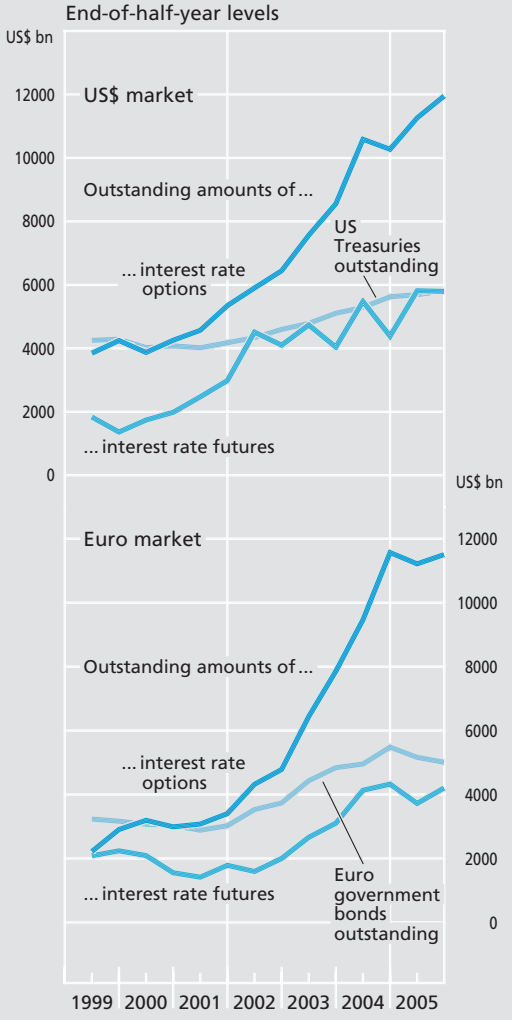
Other proposals to curb sharp swings in prices include maximum price ranges and, if appropriate, temporary trading halts. This could slow down the market's momentum and give investors more time to assess their situation and pay outstanding margin requirements. However, there is then the possibility not only of limiting the consequences of panic reactions among market participants but also that fundamentally justified price movements will be stifled – at least for the time being. In addition, upon approaching a price limit, investors could close out their positions so that, in the event of a price limit or a trading halt, they do not run the risk of ending up with an illiquid position. Such behaviour would then cause investors to reach the price limit more quickly. In the end effect, however, the measures described above are necessary to prevent dynamic overvaluation in the financial markets.

Feedback effects of dynamic hedging in the case of interest rate derivatives

Dynamic hedging strategies are demonstrably significant for other markets in much the same way that they are for the equity markets. The market for interest rate options,

Interest rate derivatives and government bonds

End-of-half-year levels



Sources: BIS and ECB. Interest rate derivatives also include bond derivatives.

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which accounts for 70% of financial options traded worldwide, is the largest segment of the market.

Although interest rate options can refer directly to interest rates, this term also covers options on bonds and on bond futures. Hedging strategies are particularly relevant whenever options dealers act as net writers. Their open positions expose dealers to interest rate

risk, which can be hedged through a variety of interest rate instruments such as first-class bonds or bond futures.

Markets for hedging instruments very liquid ...

In order to hedge open options positions using bonds and futures, these markets need to be sufficiently liquid. To insure interest rate options completely, it is necessary to have hedging instruments with the same maturity as that of the options to be insured. For the US dollar interest rate options market, Kambhu (1997) investigated how hedging transactions potentially induced by options dealers could lead to feedback effects on the markets for hedging instruments. For the USA, the empirical study showed that the markets for hedging instruments were, at the time, generally sufficiently liquid to absorb the demand for hedging created by changes in interest rates.[21] However, the demand for hedging median maturities already, in some cases, outpaced the usual volume of turnover in the markets in hedging products.

The balance between sales and purchases of options by options dealers fluctuated only marginally in recent years. At first glance, this would seem to indicate virtually no growth in demand for hedging products. However, in the summer of 2003, for instance, market liquidity problems occurred owing to demand for hedging instruments following a sharp rise in yields. This experience led to an increase in the use of other instruments, such as interest rate swaps, in order to carry out dynamic hedging strategies.

In addition, the total volume of outstanding euro and US dollar-denominated options has grown much faster than the volumes of futures and bonds. This means that feedback effects on spot markets could be caused not only by options dealers' demand for hedging products but also other market players' increased demand for interest rate derivatives – for both speculative and hedging purposes.

... yet markets for interest rate options growing fast

Conclusion

Derivatives round out financial markets

The interplay between the derivatives and spot markets will remain a topic of scholarly debate. Derivatives markets' fast growth has intensified their influence on price discovery and risk allocation in the financial markets. Now that price risks can be traded easily and at low cost, new information is processed more quickly. Derivatives trading can therefore send signals to other markets. Signals can have a stabilising effect if, for instance, the future expectations of derivatives market players influence the production and storage decisions of commodity market players.

Potential feedback effects and regulatory approaches

On the other hand, during turnarounds in market expectations and major price fluctuations, dynamic hedging strategies can also wreak havoc on illiquid spot markets. The extent to which derivatives create risk for the entire financial system is closely tied to the question of how these instruments are used in specific market circumstances. The potential feedback effects on, and systemic risks to, spot markets created by the use of derivatives raise the question of how to supervise and

21 See J Kambhu (1997), The size of hedge adjustments of derivatives dealers' US dollar interest rate options, Federal Reserve Bank of New York, June 1997.

regulate the financial markets in question. Defining the legal framework, creating a robust market structure, making information systems transparent and instituting trading halts and price ranges are at the heart of the debate on what constitutes suitable measures.

It is not enough, however, to focus regulation on exchange-traded derivatives, which are easier to supervise, as this might create incentives to shift trading activity to the OTC sector, which is more sensitive with regard to hedging and to counterparty risk.