

## Box 3

## RECENT TRENDS IN IMPLIED STOCK MARKET VOLATILITY

Implied volatility in the stock markets, which is a measure of market participants' expected near-term stock price volatility extracted from option prices, has fallen steadily across the globe over the past one-and-a-half years, to levels significantly below those recorded in recent years. Some concerns have been raised that current levels may even have become too low. This box investigates this issue based on data for the US stock market, but the conclusions drawn are likely to be broadly similar for stock markets in other major economies as well.

Chart A shows the implied volatility of the Standard & Poor's 500 index, as measured by the VIX index (the Chicago Board Options Exchange Volatility Index),<sup>1</sup> at the end of each month since January 1990, together with the realised stock price volatility for the following month calculated as the monthly standard deviation of daily percentage stock price changes. The monthly window for the calculation of realised volatility is in line with the time to expiration of the options used to calculate implied volatility. Comparing the two series may therefore provide indications as to whether and to what extent market participants' expected volatility deviated from the actual outcome in each month.

As can be seen from Chart A, implied and realised volatility show a rather high degree of co-movement. In particular, in periods when implied volatility is high, realised volatility tends to be high as well, and vice versa.<sup>2</sup>

If implied volatility is an efficient or rational expectation of the realised volatility over the coming month, then the difference between the two should be purely random. This would mean that the ex post expectation errors made by market participants are not systematic. Conversely, any systematic pattern in the deviations of expected volatility from realised volatility, e.g. a relatively long series of expectation errors of the same sign, could indicate a pricing anomaly. The difference between implied and realised volatility for the Standard & Poor's 500 index is also shown in Chart A. As is evident from the chart, the only period where expected and realised volatility differed substantially over an extended period of time is from March to October 2002. During this period, implied volatility under-predicted realised volatility quite significantly owing to some unexpected major market events such as the revelation of a series of corporate accounting scandals in the United States.

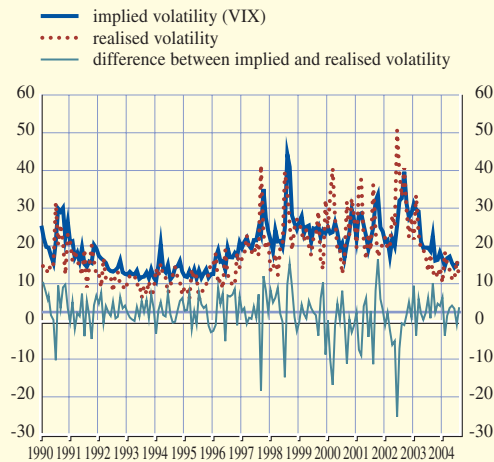
With respect to the present situation, however, there are no signs that implied volatility has systematically under-predicted realised volatility, as should happen if implied volatility were to be driven down by factors other than market participants' expected volatility. Instead, it appears that implied volatility has declined mainly because market participants observed a decline in realised volatility over previous months.

1 For a description of this index and the recently implemented methodological changes, see the corresponding White Paper by the Chicago Board Options Exchange (<http://www.cboe.com/micro/vix/vixwhite.pdf>).

2 The VIX tends, on average, to be slightly higher than realised volatility, probably reflecting several measurement biases in the two series. For a discussion of these biases, see B. J. Christensen and N. R. Prabhala (1998), "The relation between implied and realized volatility", *Journal of Financial Economics*, 50, pp. 125-50.

**Chart A Implied and realised volatility for the Standard & Poor's 500 index**

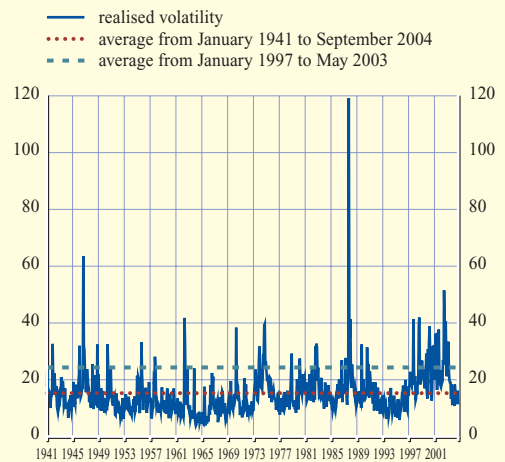
(percentages per annum)



Sources: Chicago Board Options Exchange, Bloomberg and ECB calculations.  
 Note: The straight line shows the average spread in the difference between implied and realised volatility.

**Chart B Realised volatility for the Standard & Poor's 500 index**

(percentages per annum)



Sources: Bloomberg and ECB calculations.  
 Note: The realised volatility is calculated as the annualised standard deviation of daily percentage stock price changes in each month.

Chart B puts the present situation in a historical context by showing realised volatility in the US stock market since 1941. The chart clearly indicates that in a longer-term perspective, today's level of stock market uncertainty is not historically low. Also evident from the chart is that the period from 1997 to mid-2003 was very volatile. This was quite a long episode of market turbulence starting with the financial turmoil resulting from the Asian and Russian crises in 1997-98, and fuelled further by the bursting of the presumed IT stock market bubble, a number of corporate accounting scandals and increased geopolitical tensions, amongst other things.

Hence, the uncertainties of market participants related to the past crisis-like events may at last have abated. The absence of any further major market disruptions over the past year or so has apparently made market participants confident of more stable stock market conditions, bringing expected and realised volatility back to levels more in line with historical averages.