Box 15

A DECOMPOSITION OF EURO AREA BANK STOCK VOLATILITY

Since the recovery of the euro area stock markets started in March 2003, the Dow Jones EURO STOXX banking sector index has performed strongly, increasing by roughly 80% up to November 2005.[1] Moreover, the upturn in euro area bank's stock prices has been accompanied by a declining trend in various measures of stock market uncertainty. In this respect, both realised volatility and forward-looking measures such as implied volatility on options of the bank index have declined in tandem to relatively low levels by historical standards (see Chart B15.1). This development of lowered uncertainty would imply that the risks facing the European banking sector are currently assessed as rather benign. By using data on individual bank stocks, this Box decomposes the decline in overall bank index volatility into two separate parts: the first measuring the contribution from single stock variances; and the second reflecting the covariation between stocks making up the index. Given that the degree of

1 The Dow Jones EURO STOXX 50 has increased by slightly less than 50% over the same time period.

covariation among individual banks' stock returns is important for assessing the risk of common vulnerability to similar shocks, and that this covariation from time to time may be dominated by some subset of banks (possibly changing over time), this decomposition may also provide some tentative hints about changes in the "systemic risk" embedded in financial market prices.[2]

In order to extract time-varying measures of the volatility of individual stocks and the correlation structure between them, a multivariate GARCH model of daily returns for 38 banks included in the Dow Jones EURO STOXX banking sector index is employed.[3] These estimates are then used – together with the individual weights of the banks represented in the index – to decompose the overall index volatility into both the individual variance part and the covariance part. The standard expression describing the variance of a portfolio of assets is used for the decomposition:

$$\sigma^2_{Portfolio} = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij} \ , \tag{1}$$

where $\sigma^2_{Portfolio}$ is the total variance of the portfolio and w_i represents the weight of the i:th individual stock. Chart B15.1 shows an annualised version of the calculated portfolio volatility together with the evolution of the implied volatility for the banking index and the realised index volatility. Given the rather small and unsystematic difference between the three volatility measures, the multivariate volatility model that underlies variance expression (1) may be regarded as providing a fairly sound illustration of volatility developments over the sample under consideration.[4]

One simple way of gauging information regarding euro area banking sector risk is to consider the evolution of components of expression (1), which sums elements of the co-movement between stocks. For the purposes of financial stability analysis, risk assessment typically depends on these covariance patterns, even if overall volatility is low. However, not all banks represented in the index are necessarily equally important in terms of their contribution to the total covariance component. Taking this consideration into account, the variance decomposition proposed here might shed some light on the impact of some subset of banks on total volatility.

The analysis shows that the contribution from the covariance part in (1) has remained more or less unchanged over the last few years for the index in total, fluctuating at around 85% of total portfolio variance.[5] The stable evolution of this proportion confirms that the recent decline in the volatility of the banking index has been driven by a reduction in the covariation between individual bank stocks.

2 Bank stocks are assumed to be efficiently priced in that they reflect all publicly available information, both in terms of individual banks' balance sheet risks and the relationships between different banks' risks.

3 Ten banks, accounting for less than 9% of the total bank index, have been excluded from the calculations owing to data limitations. Data from 1 June 2000 to 1 November 2005 have been used to estimate a Dynamic Conditional Correlation model with GARCH(1,1) margins. See R. Engle (2002), "Dynamic Conditional Correlation – A Simple Class of Multivariate Generalized Autoregressive Conditional Hetroskedasticity Models", *Journal of Business and Economic Statistics,* Vol. 20, No. 3, July.

4 Comparing realised volatility and volatility measures extracted from options prices may be somewhat misleading, as the former is backward-looking while the latter is forward-looking. However, as market participants tend to use realised volatility when forming their expectations about future volatility, the two measures usually exhibit similar movements over time.

5 This finding is not surprising, given that the bulk of total risk in a diversified portfolio should be made up of the covariance between the individual stocks.

Chart B15.1 Realised, implied and model-based volatility on the Dow Jones EURO STOXX bank index
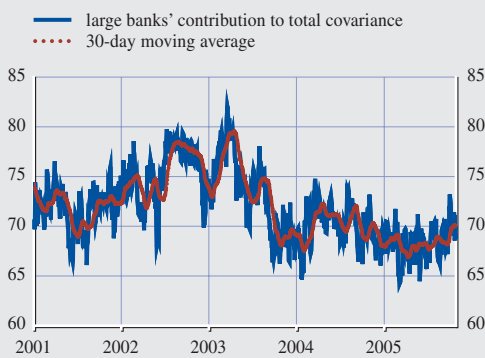
(annualised standard deviation of daily returns, %)

— realised volatility
····· implied volatility
--- model volatility
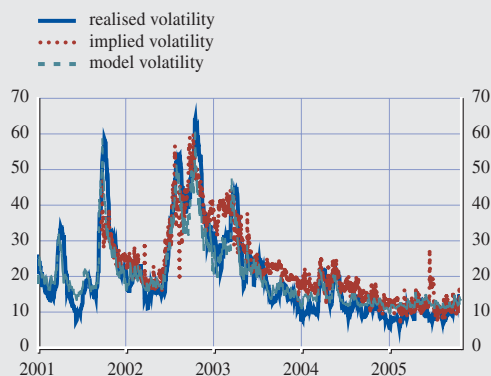
Sources: Bloomberg and ECB calculations.

Chart B15.2 Covariance contribution of the ten largest banks included in the Dow Jones EURO STOXX bank index

(% of total index covariance)

— large banks' contribution to total covariance
····· 30-day moving average

Source: ECB calculations.

From a financial stability perspective, increased co-movement between large institutions might be perceived as particularly important. An estimate of the variance contribution from a subset of the ten banks with the highest weights in the index – comprising about 60% of the total market capitalisation – shows that the level of co-movement actually declined between March 2003 and November 2005. Chart B15.2 shows that the contribution from these ten institutions alone in terms of covariation was reduced by approximately 10% of total covariance, thereby suggesting a slight reduction in "systemic risk" as measured by this particular indicator. Thus, the change in the covariance structure among euro area banking stocks, together with the observed reduction in implied volatility, lends some support to the view that risks are currently assessed as being manageable for the banking sector as a whole.