Box 13

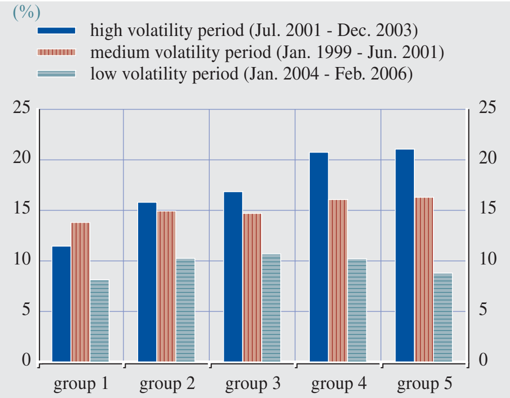
DOWNSIDE RISK IN EURO AREA BANK STOCKS

One way of gauging information about the robustness of the financial system on a continuous basis is to analyse developments in bank stock prices. From a financial stability viewpoint, knowledge of how the market behaves under extreme conditions is central. As such, it is important to take into account the well-established fact that stock returns often exhibit both excess kurtosis and skewness, which also tend to depend on actual market conditions.[1] The degree of non-normality in stock returns may also be related to firm size. By using data on individual bank stocks included in the Dow Jones EURO STOXX banking sector index, this Box investigates the downside risks associated with euro area banks from an institution-size perspective.

To assess the importance of non-normality in the distribution of observed returns in recent years, a parametric specification for conditional dependence beyond the mean and variance was estimated.[2] As expected, the aggregate bank index exhibited both strong kurtosis and negative skewness, implying a higher probability of large negative returns. The strength of these distribution features also changed across time and under various market conditions. At the individual stock level, the distributional properties of returns appeared to be quite different, depending on the size of the institution. For illustrative purposes, the set of banks was divided into five groups according to size, and for each group a VaR[3] measure was calculated over three distinct time periods: a high-volatility period ("high"), a period of volatility close to the historical averages ("medium"), and a period of low volatility ("low").

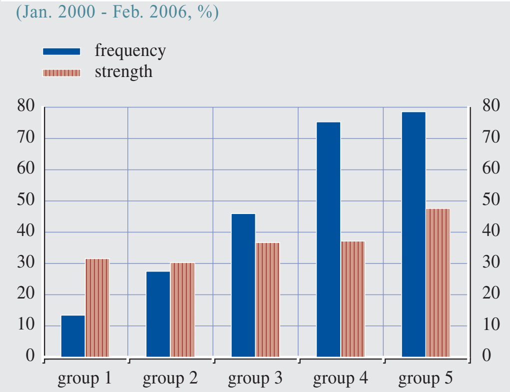
Three main characteristics can be identified. First, large banks displayed a higher level of volatility on average compared to smaller banks in times of high market volatility. These features were less pronounced in more tranquil periods, and even reversed in the most recent low volatility environment. Second, the largest banks showed a tendency toward negative skewness, i.e. a higher probability of large negative returns, whereas small and medium-sized

Chart B13.1 Value-at-Risk across size clusters under different market conditions



Sources: Bloomberg and ECB calculations.
Note: The chart shows a ten-day VaR with a 99% confidence level calculated from the non-central t-distribution. "Group 1" represents the smallest 20% of banks and "Group 5" the largest 20% of banks included in the Dow Jones EURO STOXX bank index.

Chart B13.2 Extreme-value dependence across euro area banks, sorted according to size



Sources: Bloomberg and ECB calculations.
Note: "Frequency" represents the percentage of all pairs in the group where extreme value dependence was detected based on the sample data. "Strength" represents the average dependence as measured between 0 and 100, where 100 reflects full asymptotic dependence.

1 A distribution with excess kurtosis is more peaked and has fatter tails than the normal distribution. Higher kurtosis indicates a greater probability of very large and very small returns at the expense of the probability associated with moderate returns.

2 A generalisation of the student's t-distribution, capable of handling skewness, was found to represent a reasonable approximation to the data. See B. E. Hansen (1994), "Autoregressive conditional density estimation", *International Economic Review*, Vol. 35, No 3, August, pp. 705-30.

3 The VaR represents the maximum portfolio value an investor is likely to lose with a certain probability, given a specific time horizon. In this example, a VaR with a confidence level of 99% and a horizon of 10 days is applied: $VaR_{99} = PortfolioValue_i * a_i * \sigma_i * \sqrt{10}$, where the *PortfolioValue* associated with bank i is normalised to 1, a_i represent the estimated 1% cut-off value for the non-central t-distribution, and σ_i is the stock volatility.

banks in fact displayed positive skewness, irrespective of market conditions. Third, the degree of kurtosis appeared to fall with institutional size. The results show substantially higher probabilities of large negative returns than the normal model would predict. All in all, these characteristics – the volatility, kurtosis and skewness – translate into the VaR measures presented in Chart B13.1. The strongly elevated VaR for larger institutions during the period of high volatility suggests that large banks, which arguably might matter more from a financial system stability perspective, could move more closely together during extreme conditions.

Given these tentative findings for each stock return series analysed in isolation, extreme value analysis was applied in order to assess the dependence between pairs of bank stocks at times of extreme negative shocks.[4] Hence, instead of describing the full distribution of returns, the focus of the analysis was exclusively on the left tail. For each pair of banks included in the index, the occurrence of asymptotic dependence was tested and, if present, estimated by strength.[5] Chart B13.2 shows that the occurrence of tail dependence appeared to be most pronounced among pairs of larger banks; tail dependence was detected in less than 15% of all pairs among the smallest banks, compared to almost 80% among the largest banks. The strength of dependency also seemed to slightly increase depending on the size of the institution. This result suggests that the valuations of larger – and thus potentially systemically more important – euro area banks might be more prone to move together in times of stress than their smaller counterparts.

Taking the non-normal features of euro area bank stock returns into account, this rudimentary analysis shows that the risks stemming from larger banks decreased compared to their smaller counterparts in the most recent low volatility environment. The level of risk as measured by the VaR appears to be no different, or even lower, for large banks in times of more moderate market conditions, supporting an optimistic risk outlook for the euro area banking system as a whole as long as volatility remains low. On the other hand, the level of risk seems to increase with the size of the institution in times of turbulence. As extreme-value dependence between large institutions tends to be high during these periods, this underlines the importance of monitoring the conditions of larger banks on an ongoing basis since they are more likely to be sources and conduits of systemic risk.

4 See also the Special Feature in this Review on "Assessing banking system risk with extreme value analysis".
5 The method applied in this exercise is the same as in J. Daníelsson and C. G. de Vries (1997), "Tail index and quantile estimation with very high frequency data", *Journal of Empirical Finance*, 4, pp. 241-57. Intuitively, asymptotic dependence between a pair of banks could be described as a case in which the number of times that the returns from the banks jointly exceed a high threshold (represented by large negative returns) decreases slowly with the threshold.