

Box 16

**A MARKET-BASED INDICATOR OF THE PROBABILITY OF ADVERSE SYSTEMIC EVENTS INVOLVING  
LARGE AND COMPLEX BANKING GROUPS**

One of the defining features of the recent market turmoil was the extent to which cash credit and related derivative markets were affected. Credit default swap (CDS) spreads widened significantly for banks and other financial institutions and in August/September and again in early November they reached levels not seen since the beginning of 2003. The recent market turmoil can be distinguished from the turbulent episodes observed during May 2005, May-June 2006, and February-March 2007 by its more protracted nature and because it may imply more serious consequences for the banking sector. Using the CDS spreads and equity returns of large and complex banking groups (LCBGs), this box provides an empirical evaluation of the probabilities of simultaneous defaults among

LCBGs. More specifically, it outlines a new financial stability indicator – the market perception of the probability of an adverse systemic event occurring among euro area LCBGs as well as among global LCBGs, whose financial condition is likely to have an important bearing on systemic stability in the euro area – and it assesses how this indicator was affected by recent market turmoil.

The risk-neutral forward-looking implied probability of default of an individual bank can be evaluated using CDS spreads. Taking into account default correlations within the framework of an  $n$ th-to-default CDS basket pricing model,<sup>1</sup> it is possible to assess the probability of the joint default of two or more banks. In this approach, the default correlation matrix between banks is approximated by their equity return correlation matrix. Then, using factor analysis, the equity returns are decomposed into unobserved  $m$  systematic factors ( $M_1, \dots, M_m$ ) and idiosyncratic parts.

The default probability of each bank, conditional on common factors, can be evaluated using the standard Merton approach:<sup>2</sup>

$$\Pr(x_i < \bar{x}_i | M) = H \left[ \frac{\bar{x}_i - (a_{i1}M_1 + \dots + a_{im}M_m)}{\sqrt{1 - a_{i1}^2 - \dots - a_{im}^2}} \right],$$

where the  $a_{ij}$ 's are the factor loadings of the underlying latent factor model of equity returns of bank  $i$ , and  $x_i$  is a random variable representing the value of the financial institution. A fall in this value below a specified threshold  $\bar{x}_i$  indicates default of a bank.  $Q_i(t_i \leq t)$  is the cumulative risk-neutral probability that institution  $i$  will default before time  $t$ . Using a percentile-to-percentile transformation, the probability distribution of  $x_i$  is mapped to the probability distribution of  $t_i$ . The model requires various other inputs such as the default hazard rates of individual LCBGs which are inferred from the quoted CDS spreads. Finally, the probabilities (both conditional on the estimated common factors and unconditional) that exactly  $n$  defaults will occur over time  $t$  are computed.

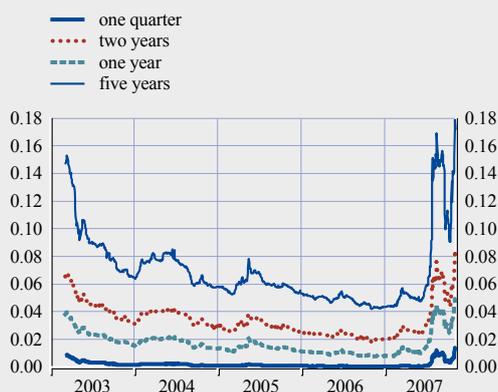
The probability of default of two or more institutions can be interpreted as the probability of an adverse systemic event because this evaluation technique takes account of default correlations between institutions (based on market information). Thus, the probability of an adverse systemic event should be a good indicator of the systemic risk to which LCBGs included in the basket are exposed.

Based on a CDS basket of 22 global LCBGs, including euro area and non euro area based institutions (for which data are available), the evaluation of the probability of an adverse systemic event in the euro area increased markedly over the July-August 2007 period and again from mid-October onwards. At the beginning of November 2007, the probability of two or more LCBGs defaulting simultaneously over horizons of one quarter, one year, two years and five years all exceeded the high levels of early 2003, when the euro area banking sector last faced a very challenging operating environment (see Chart A). Similar calculations made for a sub-set CDS basket of ten euro area LCBGs, for which the necessary data was available, indicates that

1 The methodology applied in this box draws heavily on the methods proposed in R.G. Avesani (2005), "FIRST: A Market-Based Approach to Evaluate Financial System Risk and Stability," *IMF Working Paper*, No. 05/232, and R.G. Avesani, A.I. Garcia Pascual and J. Li (2006), "A New Risk Indicator and Stress Testing Tool: A Multifactor Nth-to-Default CDS Basket", *IMF Working Paper*, No. 06/105.

2 See R.C. Merton (1974), "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance*, Vol. 29.

**Chart A Implied probabilities of two or more global and euro area large and complex banking groups defaults over different time horizons**



Sources: Bloomberg and ECB calculations.

**Chart B Implied probabilities of two or more euro area large and complex banking groups defaults over different time horizons**



Sources: Bloomberg and ECB calculations.

the market assessment of the probability of an adverse systemic event affecting these institutions has been systematically lower than for the set of global LCBGs for the entire estimation period (see Chart B). However, patterns in this indicator mirrored those based on the larger set of institutions, increasing significantly in the second half of 2007 to reach around the same levels as those seen in early 2003. The rise in the market assessment of the likelihood of an adverse systemic event evaluated for both CDS baskets resulted from both an increase in the correlation of stock price changes among the individual institutions and from a pick-up in CDS spreads.

An important caveat to this analysis is that the results are likely to be biased towards the upside by the assumption of risk neutrality and factors which influence the accuracy of price discovery process, e.g. liquidity conditions in the CDS market etc. Hence, changes in rather than the levels of the indicator are likely to be more informative.

Placing recent developments into a historical context, this measure of the probability of an adverse systemic event, as assessed by market participants, rose to much higher levels than those seen during the episodes of market stress observed over the past two years. In contrast to the past events, on the face of it, it seems that the recent market turmoil was assessed by market participants in early November 2007 as having the potential for much more far-reaching systemic consequences for LCBGs. However, this market-based assessment needs to be considered together with the analysis presented in Box 11 that shows that when second-round effects are excluded, many of the euro area LCBG's are not likely to be seriously affected by the turmoil. Hence, one interpretation of the notable rise in these indicators in the second half of the year is that it either reflected expectations of severe second-round effects or an overreaction relative to the underlying deterioration in the financial positions of the LCBGs concerned.