Box 5

THE IMPACT OF THE LONGER-TERM REFINANCING OPERATIONS ON MONEY MARKET OPTIONS

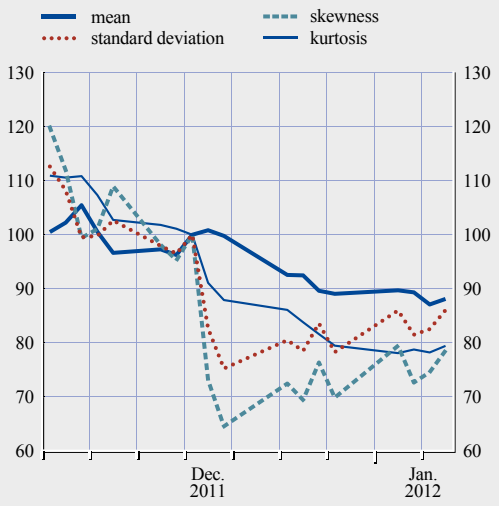
The Eurosystem's December 2011 and February 2012 three-year longer-term refinancing operations (LTROs) targeted deficiencies in bank term funding markets, and were instrumental in preventing a credit crunch that could have compromised the maintenance of price stability in the euro area. Notwithstanding the clear and targeted objective of this policy action, it appears to have reverberated well beyond the banking system and into the broad financial system. This, in turn, appears to have stemmed from its inherent boost to market confidence, and more specifically its effect of removing the distributional "tail risk" of an extreme event occurring in the economic and financial environment.

This box focuses on the measurement of such tail risk and uncertainty. Positive confidence shocks, such as the one linked to the LTROs, are expected to be reflected in risk-implied probability densities extracted from option prices, as such data embody market participant expectations.[1] To understand the extent to which the most recent non-standard measures (the three-year LTROs) have had an impact on market confidence, first the statistical moments of the implied

1 For a detailed description of the implied distribution methodology applied by the ECB, see J.M. Puigvert-Gutiérrez and R. de Vincent-Humphreys, "A Quantitative Mirror On The Euribor Market Using Implied Probability Density Functions", *Eurasian Economic Review*, 2(1), 2012.

Chart A EURIBOR three-month implied probability distribution moments around the first LTRO

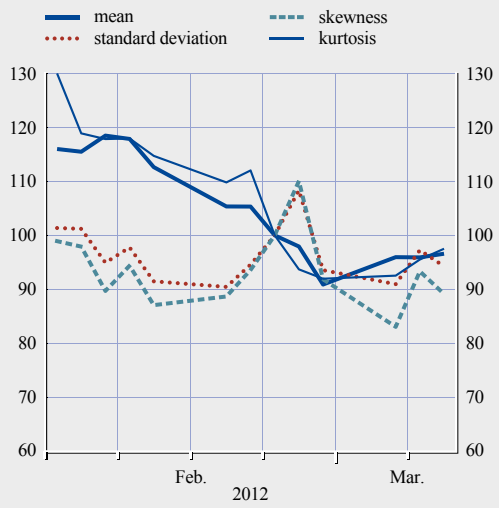
(index: 21 December 2011 = 100)



Sources: Bloomberg and ECB calculations.

Chart B EURIBOR three-month implied probability distribution moments around the second LTRO

(index: 29 February 2012 = 100)



Sources: Bloomberg and ECB calculations.

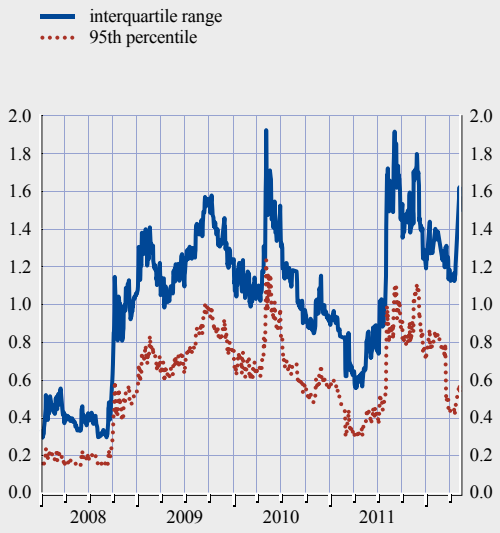
distributions for the three-month EURIBOR around the two LTROs and subsequently the time series of two implied distribution characteristics are analysed. To begin with, the focus is on tail risk, i.e. the probability of an event far away from average expectations. Practically, this implies examining an extreme quantile of the option-implied risk/return probability distribution – calibrated here to be the 5% or 95% quantile. Second, such analysis is complemented with a measure of uncertainty, or a measure of how spread out the distribution of market expectations is from the mean. This again implies in practical terms an examination of the interquantile range of the option-implied risk/return probability distribution – calibrated here to be the mass of the distribution falling between the 95% and 5% quantile.

Charts A and B show the behaviour of the statistical moments of the EURIBOR three-month probability distributions around the LTRO dates. A decrease of the skewness indicates a tendency for market participants to expect future interest rates to be below the mean rather than above it; the lower kurtosis suggests that the likelihood that market participants attach to more extreme outcomes compared with outcomes at the centre of the density has declined. This is especially evident after the first LTRO, but seems to be less pronounced for the second LTRO.

The above analysis of a changing distribution over time is corroborated by a more detailed view of the dynamics of specific segments of the return distributions (see Charts C and D). For both markets (upper tail risk for the money market and lower tail risk for the equity market), three distinct periods of tension can be identified as having given rise to significant tail risk and uncertainty. First, the failure of Lehman Brothers in September 2008 was followed by heightened tail risks: market participants priced with a risk of 5% a positive 60 basis point jump in the EURIBOR and decreases by 52% and 45% for the Dow Jones EURO STOXX 50 index and the Dow Jones EURO STOXX bank index, respectively, in the subsequent three months. These jumps in tail risk were associated with a broader interquantile range, thus more uncertainty. A second period of tensions appeared in May 2010, associated with the initial stages of the euro area

Chart C EURIBOR: extreme quantile and interquantile range

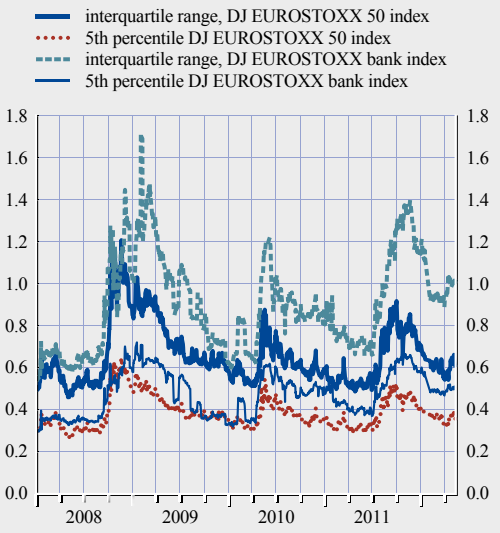
(Jan. 2008 – May 2012)



Sources: Bloomberg and ECB calculations.

Chart D Stock markets: extreme quantile and interquantile range

(Jan. 2008 – May 2012)



Sources: Bloomberg and ECB calculations.

sovereign debt crisis. While this led to an initial spike in tail risk and uncertainty, this quickly dissipated in the context of a relatively positively perceived economic outlook, along with policy actions (such as the ECB's non-standard measures and measures announced by European governments). Such improvements in tail risk and uncertainty came to a sudden halt in July 2011, when the tail risk and uncertainty associated with EURIBOR rose back to its May 2010 level, while the stock market tail risk and uncertainty were close to levels right after the failure of Lehman Brothers. Most recently, the first three-year LTRO at the end of December 2011 appears to have been a turning point for both markets, with lower tensions, even though the level of each indicator was still high and it remains to be seen whether their decrease will be confirmed in the coming months: the most recent increase in these indicators shows that financial market risks can still be sharply and quickly reassessed by market participants.

All in all, implied distributions drawn from options on European money and equity markets suggest a decisive recent role played by policy action in curbing the risk of extreme events and, more generally, uncertainty. Their historical evolution suggests, however, that such impacts can be short-lived – which in the current context implies a strong need for concrete action on the part of governments and banks following the Eurosystem's three-year LTROs to secure a lasting improvement in economic and financial fundamentals.