

## Box 6

A comparison of market-based indicators of banking system stress

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**One standard market-based indicator of systemic risk regularly presented in the Financial Stability Review is the probability of default of two or more banking groups in the euro area.**<sup>50</sup> Recently, a number of alternative methodologies have become available which measure similar market-based banking stress probabilities. The main aim of this box is to cross-check the information content of these alternative measures with the ECB's core indicator.

**The ECB's standard indicator is forward-looking and uses market data in the form of bank equity returns and credit default swap (CDS) spreads as inputs to the model.** More specifically, it uses market equity returns over time to estimate the interconnectedness between different large and complex banking groups (LCBGs), and it uses market CDS spreads to extract bank-specific probabilities of default. Both pieces of information are combined within a factor model to capture the market perception of the probability of two or more credit events over a two-year horizon among euro area banking groups.

**In this box, the ECB's standard model is cross-checked with two alternative indicators of bank stress.** Both indicators are based on the copula technique. Copulas allow an efficient combination of individual probabilities of default of different LCBGs, even if one assumes complicated functional dependences among them. Hence, they are well suited to estimate joint probabilities of default within different statistical frameworks.

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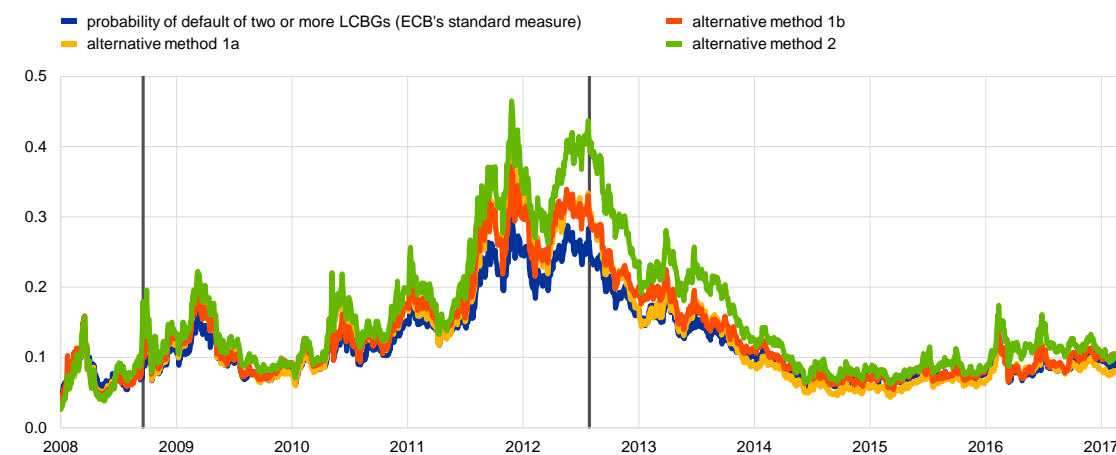
<sup>50</sup> See the box entitled "A market-based indicator of the probability of adverse systemic events involving large and complex banking groups", *Financial Stability Review*, ECB, December 2007, pp. 125-127.

## Chart A

### Similar pattern of euro area bank stress across methodologies

#### Probability of two or more credit events over a two-year horizon for 15 large euro area banks

(Jan. 2008 – Feb. 2017; daily data; percentages)



Sources: Bloomberg and ECB calculations.

Notes: "Probability of default of two or more LCBGs" refers to the probability of simultaneous defaults in the sample of 15 LCBGs over a two-year horizon. The first black line refers to the Lehman Brothers bankruptcy and the second to the initial OMT announcement in the summer of 2012.

The first indicator assumes time-varying volatilities and allows for potential fat tails in the parametric description of the data.<sup>51</sup> Two versions of this approach are employed: one in which time-varying correlations are modelled explicitly and one in which correlations are computed in a more ad hoc fashion using a 75-day rolling estimation window (alternative methods 1a and 1b in **Chart A**). The second indicator also allows for time-varying volatilities and fat tails in the data, but it simplifies the interconnectedness across different banking groups into a single time-varying parameter to reduce the mathematical complexity of the approach. This simplification permits the extension of the indicator to many more banks if necessary (alternative method 2 in **Chart A**).<sup>52</sup>

**To make the comparison across approaches meaningful, a common sample of CDS spreads for 15 large euro area banks is used to compute the respective joint risk estimates.** To further enable a comparison across methodologies, the recovery rates (or loss given default) used to derive probabilities of default from CDS spreads and the interest rates used for discounting are kept constant across models. As a result, the CDS spreads can be mapped into comparable idiosyncratic default probabilities. An important caveat to keep in mind is that CDS-implied default probabilities are based on risk-neutral probabilities, which tend to be higher than actual default probabilities. As a result, the systemic stress probabilities reported in the analysis overestimate risk. Thus, changes in the indicator levels are likely to be more informative than the levels themselves.

**Overall, the results suggest that the ECB's standard measure of bank stress displays a pattern that is similar to the alternative approaches outlined above (see Chart A).** Across methods, the market-implied probability of two or more credit events over a two-year horizon hovered at low levels prior to the global financial crisis. Between 2008 and mid-2012, euro area banking sector stress increased sharply, as the financial crisis spread to the real economy. From

<sup>51</sup> Lucas, A., Schwaab, B. and Zhang, X., "Conditional euro area sovereign default risk", *Journal of Business & Economic Statistics*, Vol. 32(2), 2014, pp. 271-284.

<sup>52</sup> Lucas, A., Schwaab, B. and Zhang, X., "Modeling financial sector joint tail risk in the euro area", *Journal of Applied Econometrics*, Vol. 32(1), 2017, pp. 171-199.

mid-2012 to 2014 the stress indicators covering the euro area banking sector gradually fell – initially sparked by the announcement of Outright Monetary Transactions (OMTs) and subsequently driven by the gradual recovery in economic growth prospects. In the last two years, the various stress indicators for euro area banks have remained fairly stable, despite occasional bouts of volatility in banks' share prices and overall low profitability, perhaps reflecting the gradual increases in banks' capital buffers.

**To conclude, market-based measures of systemic stress in the euro area banking sector are an important tool for the ECB's financial stability analysis.** This box compares the ECB's standard market-based tool for gauging banking system stress with some alternative methods. Overall, all banking system stress indicators display a similar pattern over time. Thus, from a model-based perspective, the ECB's standard market-based tool for measuring banking risk is robust to alternative specifications. This notwithstanding, market-based measures of banking stress should be interpreted with some caution. While the measures rose to what were, at the time, historically high levels in August 2007, when the sub-prime crisis erupted, they did not provide clear-cut early warning signals sufficiently far ahead of the global financial crisis that followed.<sup>53</sup>

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<sup>53</sup> The underestimation of priced risk before times of stress has sometimes been referred to as the "financial stability paradox". See, for example, Borio, C., "Implementing a macroprudential framework: Blending boldness and realism", keynote address at the BIS-HKMA research conference on "Financial Stability: Towards a Macroprudential Approach", Bank for International Settlements, July 2010.