Box 8

Measuring the propagation of macro-financial shocks at the level of individual euro area financial institutions

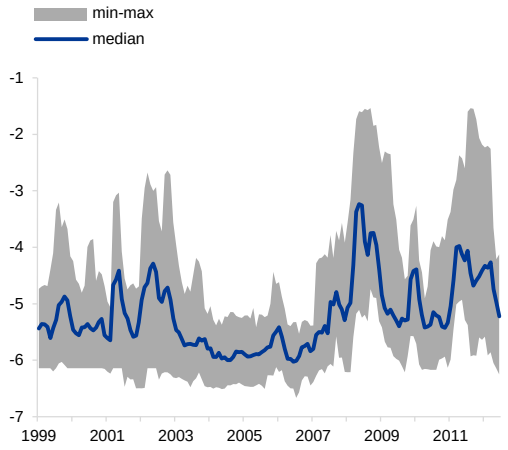
The global financial crisis has highlighted that impaired financial institutions can significantly propagate aggregate or institution-specific stress to the overall economy. With financial contagion a key conduit of these impacts, data at the individual firm level are crucial to account for both cross-firm and macro-financial linkages. While traditional stress-testing methods offer considerable insights into these interdependencies, their findings can be complemented by the use of reduced-form models that exploit past empirical regularities. One such framework, drawing on the infinite-dimensional vector autoregressive (IVAR) framework of Chudik and Pesaran, includes both firm-level risk indicators and a global set of macroeconomic variables.[73] This approach offers a means of linking firm-level default probabilities to aggregate international macro-financial variables.

Chart A

Financial stress at 35 large financial firms in the euro area has varied widely over the last 15 years

Default probabilities for 35 firms in the sample

(July 1999 – Dec. 2012; log-odd ratio transformation, monthly data)



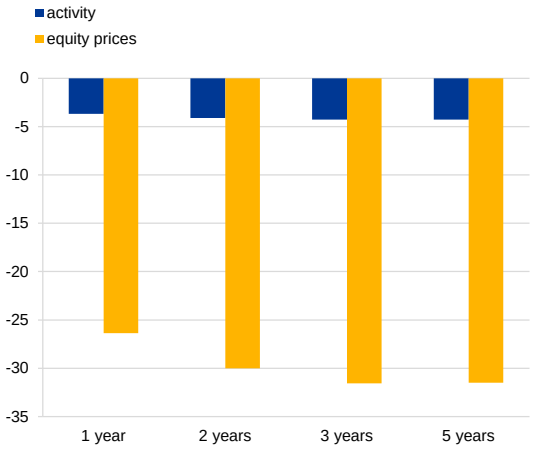
Source: Kamakura.
Notes: As the default probabilities (DP) are defined on the interval [0; 1], a log-odd transformation is used for firm i $(x_{i,t})$ defined on the interval $(-\infty; +\infty)$ for each firm: $x_{i,t} = \ln(\frac{DP_{i,t}}{1-DP_{i,t}})$.

Chart B

A US equity shock has strong real and financial spillovers to the euro area economy

Impact of a negative US equity shock (20% decline) on euro area equity prices and economic activity

(percentage points)



Note: Economic activity is measured by industrial production (monthly data).

Firm-level dynamics during the crisis suggest a strong role for heterogeneity. On aggregate, default probabilities tended to peak towards the end of 2008 during the period following the Lehman Brothers bankruptcy (see Chart A).[74] At the same time, some firms experienced stronger distress

[73] See Chudik, A. and Pesaran, H., "Infinite dimensional VARs and factor models", *Journal of Econometrics,* Vol. 163, 2011, pp. 4-22, and Al-Haschimi, A., Dées, S., di Mauro, F. and Jančoková, M., "Linking distress of financial institutions to macro-financial shocks", *Working Paper Series*, No 1749, ECB, 2014.

[74] Due to the lack of harmonised bankruptcy data, the exercise presented here is based on 12-month-ahead default probability measures obtained from the Kamakura Corporation for 35 euro area financial firms (banks and insurance companies). Altogether, the firms selected capture more than three-quarters of all assets in the Kamakura database for financial firms in the eight largest euro area countries.

during the euro area sovereign tensions in early 2012, while other firms showed high stress episodes in the early 2000s.

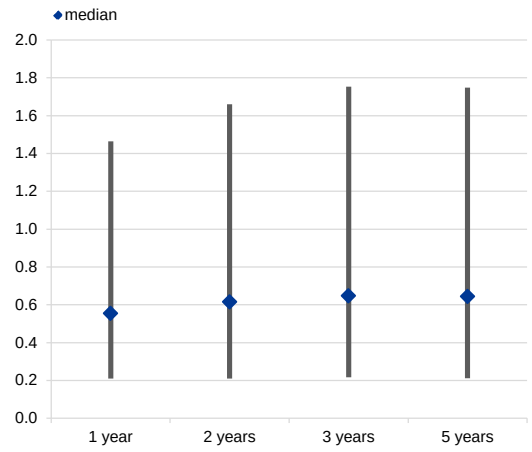
Building on this evidence, the international transmission of shocks can be assessed within the global IVAR framework of Al-Haschimi et al. through the lens of two simulations: (i) a simulated decline in US equity prices by 20% (which is close to the decline in stock prices observed following the Lehman Brothers bankruptcy); and (ii) the impact of a shock to the default probabilities of global systemically important financial institutions (G-SIFIs) – each presented in turn below.

Chart C

The US equity shock also leads to a significant rise in financial stress in euro area G-SIFIs

Impact of a negative US equity shock (20% decline) on the default probability of euro area financial institutions

(absolute change in log-odd ratio)



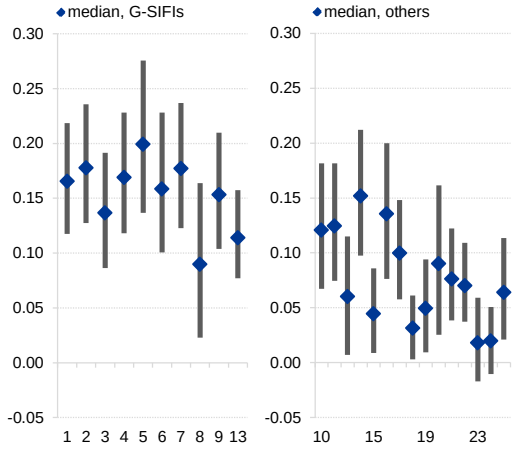
Notes: Default probability in log-odd ratio transformation (see the notes to Chart A). The bars denote min-max ranges. The diamond shows the median of the response distribution among the 35 financial firms.

Chart D

Financial stress in euro area G-SIFIs has significant spillover effects on other large euro area banks

Impact of a one-standard-deviation shock to the default probabilities of the G-SIFIs on euro area financial institutions' default probabilities

(absolute change in log-odd ratio)



Notes: Default probability in log-odd ratio transformation (see the notes to Chart A). The diamonds show the peak median response of each firm over the first 60 months. The bars denote the 10th-90th percentile ranges around these peaks. The left panel corresponds to the default probabilities of the 10 G-SIFIs in the sample. The right panel corresponds to the default probabilities of the next largest 15 financial institutions. The x-axis shows the number of each firm, the firms being sorted from the largest by assets to the smallest. Firm 13 is a G-SIFI.

Results from the first simulation suggest that a 20% decline in US equity prices has a strong international spillover effect on the euro area economy and financial institutions. Euro area equity prices decline and the shock to US equities also affects real variables, with euro area industrial production declining by 3.4% after one year and remaining 4.2% below the level reached without the shock after five years (see Chart B). Importantly, the adverse financial shock in the United States has sizeable spillover effects on euro area financial institutions, albeit with marked heterogeneity among the responses across firms. A negative shock to equity prices in the United States has an adverse impact on the default probabilities of euro area financial firms that is of an economically significant magnitude when considering recent historical episodes such as the financial crisis (see Chart C). Moreover, the results show that the model can capture significant spillovers between financial firms, as the transmission of the macro-financial shocks to the financial institutions is amplified by the cross-firm linkages.

The second simulation suggests that a shock to the default probabilities of the euro area G-SIFIs yields significant and heterogeneous impacts on other institutions (see Chart D). There is a positive and statistically significant spillover of firm-level distress from the G-SIFIs to the majority of – typically larger – financial institutions. By contrast, some smaller firms lack statistically significant responses in their default probabilities.[75] Notably, the median responses of some of the largest non-G-SIFI financial institutions are of a similar order of magnitude to the responses of the G-SIFIs themselves, while other financial firms experience a much more muted spillover or contagion effects from the distress of G-SIFIs. This points to the importance of using firm-level data to capture essential differences in institution-specific responses to financial stress.

All in all, these applications of the methodology suggest heterogeneous impacts of common shocks, as do the applications to systemically important institutions. An analysis of firm-level data is essential in this regard, as assessments using aggregate banking sector-level indicators fail to differentiate between the varied impacts of both common and idiosyncratic shocks. With such firm-specific risk, the considerable granularity in the current macroprudential toolkit appears well suited to assessing financial stability risks, with a capacity to strengthen the resilience of the financial system accordingly.

[75] Note that in Chart D, the responses of the largest 25 firms are shown to improve readability. The impulse responses of the remaining ten smallest firms all have positive peak median responses, but about half are not statistically significant. This is likely due to smaller financial institutions being relatively more affected by local shocks, which are not explicitly modelled in this framework (for full results, see Al-Haschimi et al., loc. cit., 2014).