Discussion

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The paper by Gropp and Vesala presents an empirical model that relies on market-based indicators to measure the probability that a European bank faces financial difficulty given that other European banks are also experiencing difficulty. Consequently, two elements are needed for this purpose: (i) pertinent market-based indicators; and (ii) a measure to determine whether a bank is in difficulty.

To find relevant market-based indicators, it is important to identify the channels through which shocks are transmitted from one bank to another. The authors identify four such channels: (i) direct/indirect financial linkages ("exposures" contagion); (ii) knowledge about such links ("information" contagion); (iii) speculation about these links ("pure" contagion); and (iv) common macroeconomic shocks (fundamentals). As for the measure, the authors consider the distribution of relative changes in banks' distance to default, and to classify a bank in the "under difficulty" category, they compare its distance-to-default change to some cut-off point (95 per cent and 99 per cent) in the distribution. Finally, an additional aspect of their modelling strategy is that they use a logit model.

I find the authors' approach intuitive and appropriate. In addition, models that rely on market-based indicators can be very useful tools for central bankers. I will first place the paper in the context of the literature on contagion and then offer some suggestions to the authors.

In the literature, four main issues present themselves. They are all addressed by the authors and should be kept in mind when interpreting the results.

First, which definition of contagion should one use? Some researchers believe that contagion occurs only when there is co-movement in excess of fundamentals. Others attribute contagion to co-movement resulting from

irrational behaviour. Still others presume that contagion exists when shocks are transmitted between two financial entities, whether or not they occur through fundamental channels. The authors make it clear that they use a fairly wide definition of contagion. Thus, while they attempt to control for macroeconomic fundamentals, they are likely to find more evidence of contagion than if they had defined the latter to be of "pure" form only.

Second, it is by now well known that the correlation between financial entities is likely to be very different in quiet times, compared with the correlation in turbulent times. Accordingly, to determine whether there is contagion, it is important to compare the event with those that occur exclusively during turbulent times. Indeed, the authors recognize this fact and focus their analysis on the tail of the distance-to-default distribution. Of course, in this case, one wonders what the appropriate cut-off point should be (as mentioned, the authors use cut-offs points of 95 per cent and 99 per cent as possible options).

Third, even while focusing on turbulent times, researchers in the contagion literature have acknowledged the possibility that correlations may not be stable over time. The authors are also aware of this and consider various subsamples for their analysis.

Finally, the complement to understanding the occurrence of contagion is trying to predict it—something that is exceedingly valuable to central bankers. Accordingly, the authors suggest a method to predict its probability of occurrence, using a fairly flexible (logit) model.

Given the above, the following suggestions may help refine the authors' analysis:

- include a world fundamental among the macroeconomic variables (e.g., the change in U.S. interest rates) to capture factors that are common to more than one country and that may prove important for the cross-border results.
- include a country "institutional fundamental" dummy (since taxation and regulation laws likely differ substantially across countries, e.g., the United Kingdom and France).
- separate I_{tk} into two categories, based on bank weakness. An example that illustrates the importance of this is: consider banks 1 and 2, and let d_t^i be the distance to default of bank 1 at time *t*. Then, for $d_{t-1}^1 = 10$ and $d_t^1 = 5$, the measure is 0.5, as is the case for $d_{t-1}^2 = 2$ and $d_t^2 = 1$. However, bank 2 is much weaker than bank 1.

- test the interest rate in levels for stationarity.
- avoid using quarterly or annual data for the macroeconomic fundamentals alongside the monthly data, since the former include future information and can bias the estimates. Instead, the authors could consider the U.S. long-short spread, which is both stationary and available at the monthly frequency.
- analyze contagion among large banks separately from that within small banks, since the type of shocks hitting one or the other category is likely very different and could introduce heteroscedasticity in the model as it is now.
- conduct robustness tests; endogeneity may be an important concern.