

Large bank contribution to systemic risk

Last week we outlined the significance of systemic risk. We described an approach to modelling such risk by conceptualising a market as a network of connected entities. This is particularly important for banks, which lend to one another. The connections that help them to dissipate risk can become overwhelmed, creating a domino effect. In this article, we consider the possibility that South Africa’s large banks contribute disproportionately to systemic risk.

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	Bank 1	Bank 2	Bank 3	Bank 4	Bank 5	Bank 6	Bank 7	Bank 8	Bank 9	Bank 10	Bank 11	Bank 12	Bank 13	Bank 14	Bank 15	Bank 16	Bank 17	Bank 18	Bank 19	Bank 20	Bank 21	Bank 22	Bank 23
Bank 1	1	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86	.86
Bank 2	.79	1	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79	.79
Bank 3	.64	.64	1	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64	.64
Bank 4	.40	.40	.40	1	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
Bank 5	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 6	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 7	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 8	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 9	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 10	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00	.00
Bank 15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00	.00
Bank 16	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00	.00
Bank 17	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00	.00
Bank 18	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00	.00
Bank 19	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00	.00
Bank 20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00	.00
Bank 21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00	.00
Bank 22	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1	.00
Bank 23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1

Table 2: Bank-specific average probabilities of default, random probability of connections

Note. This table shows, for each combination of shocked banks (down the left) and impacted banks (across the top) the probability of bank default across the study period on the Erdős-Rényi network structure and Assumption Set 1. Unity values through the diagonal are consistent with the shocked bank always being impacted.

Large banks are systemically risky right? Losses at a behemoth are surely more likely to trigger a disaster than the corresponding difficulties at a small entity? This appears to be so obviously self-evident it does not bear further examination. But what if the market were to look completely different in the absence of these giants.

Disproportional contributions

The table above shows the empirical probability that the collapse of a bank (rows, in decreasing order of bank size) causes a similar impact at one of its counterparts (columns). Four observations are immediate. First, the diagonal consists of 1s: the shocked bank has gone under in every case. Second, the likelihood of disaster at each of the other banks, conditional on collapse of our shocked bank, is the same. Third, the highest values are at the top, corresponding to the largest banks. Fourth, the high

probabilities for the first four banks, disappear for the fifth and all others.

So far, we haven’t achieved anything but show that large banks are more likely to trigger losses at other banks. But what if they were not there? Would the system propagate in similar ways from the new giants to their smaller counterparts.

The answer is strangely not. When we remove banks 1 and 2, bank 5 becomes a contributor to risk at a probability of 49%, again for all other banks. But if we take out the largest five entities, the picture is completely different. Now, the probability of a triggering collapse is largest for bank 8, at 5%, followed by bank 6 and bank 7, at 1%, but zero for the others. It appears that the market would not show the current attributes of systemic risk were the largest five entities not present.

Every researcher must ask honest questions about the possibility of invalid conclusions. In this case, the hypothetical counterfactual stretches credibility. Surely the strategic of the other banks would change were they suddenly the largest, for example? Several other limitations of the research method are acknowledged. For instance, interbank exposures are not explicitly modelled. Still, we should ask what might be learned from this experiment. At the very least, the structure and approaches of the 18 medium and small banks forming part of this study appear materially different from those of the largest. This alone provides food for thought to banking regulators.

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