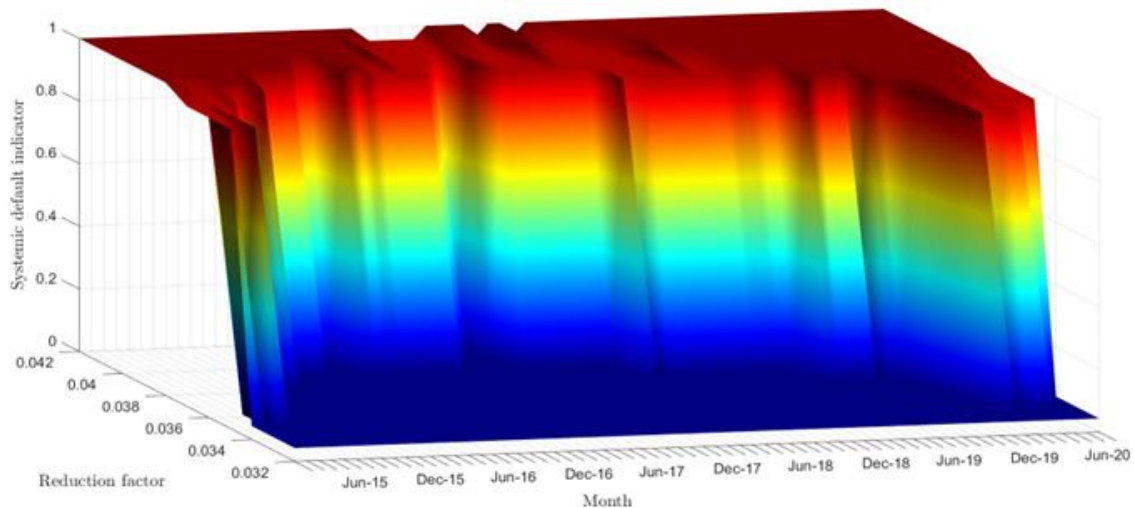


Tipping points in network models of systemic risk

Two weeks ago, we described the importance of systemic risk. Last week we considered the possibility that South Africa's large banks contribute disproportionately to such risk across the sector. This article puts forward tentative evidence that the nature of such risk is catastrophically impacted by small changes to the values taken by some of the modelling variables under certain conditions. The system, in other words, is structurally unstable.

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A network model is a simplified representation of the relationships between market entities. By way of reminder, in this instance, we use monthly data on South Africa's banks to test the potential for a shock at one bank to trigger widespread devastation in others. This is a little like tipping over one domino in an arrangement and assessing how many others fall because of this. The key output is referred to as a *systemic default indicator*. It has a minimum value of around 0.04—depending on how many banks are in the network—and a maximum of 1. This maximum is reached when all banks are deemed insolvent at the end of the experiment. All dominoes fall.

Sensitivity to assumptions

We use several models to describe the relationships between banks. Under one model, we assume that the links between large banks are more likely than the corresponding link between large banks and their smaller counterparts. In another, we assume that the probability of a link between a pair of banks is randomly determined. The results shown here are not materially impacted by the model utilised.

We also use several assumptions regarding the effect of a disaster on a receiving bank. One of these concerns

the cost of increased provisions and mark-to-market effects on the financial position of an impacted bank. Under our base assumption, we assume that this cost is 1.5 percent of short- and medium-term assets and 3 percent of long-term assets. Then we test the impacts of proportional increases to this, to 2 (and 4) and more.

The chart on this page demonstrates the incremental modelled impacts of altering this parameter. The front-to-back axis shows the value of this parameter at the short end. This is doubled for longer-term assets. The bottom-to-top axis is the systemic default indicator, no contagion at the blue bottom, disaster at the red top. Time varies from left to right. At all dates, a change of up to 3 percent on impacted banks is insufficient to affect them. At 4 percent all but one bank collapses, at all dates.

This shows enormous sensitivity to one factor. This suggests that banks hold similar levels of solvency capital—rational but dangerous—and hence that they are similarly impacted by a shock whose value is the same for all of them. Furthermore, the value of this tipping point varies over time. When conditions are stressed, like at the left and right extremes of the time range, less of a change causes widespread damage.

Every model is a simplification of reality. The impacts of such simplification should be understood. In this case, it is unlikely that all banks suffer the same impact. But it is not impossible. This analysis illustrates one of the dangers of a regulatory system that imposes the same requirements on all entities. Should they be similarly impacted by the same external effects, they could well collapse together when a tipping point is reached.

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