Network modelling of systemic risk

This series closes with five articles discussing research into the potential for South African banks and insurers to contribute to systemic risk. This note serves as an introduction. It describes systemic risk and considers why it matters. It also sets out in simple terms the principles underpinning the assessment of systemic risk using network models.

Articles are available at www.tresconsulting.co.za **16 MAY 2026**

Few would argue against the thesis that the financial sector is a key player in any marketplace. Financial entities—economists sometimes refer to them as intermediaries—provide the critical functions that enable transactions across time and space between the players in an economy. They enable transactions, facilitate trade, price and insure risk and provide a store of value.

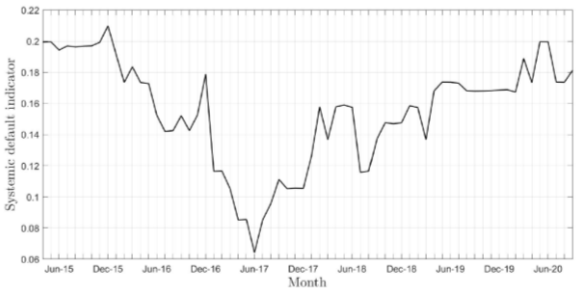
With expanding significance has come growing interconnectedness. Like the proverbial pile of sand that collapses, apparently without warning, when a single grain is added to it, this ecosystem is complex and fragile. Banks are particularly prone to this fragility. They are characterised by high levels of co-dependence. Their risk-sharing strategies provide channels for stress release. Such pathways become the media for contagion when stress levels are too high.

Mind the externalities

If a financial entity behaves irresponsibly, but in a way that only affects it and its customers, then regulators are concerned that these customers are protected. Several of the articles in this series have considered the importance of sound corporate governance and risk management, in the interest of these customers. These principles underpin the rationale for financial-sector regulation.

In contrast, when the actions of an entity may have adverse consequences extending far beyond itself and its customers, special care is required. Such impacts are called externalities. The crisis of 2008 had widespread adverse impacts with global reach. Closer to hand, the VBS debacle did not just impact the bank and its customers. It brought down several other related entities.

Regulators have a special interest in systemic risk because of these potentially widespread impacts. But they also have deep interest because of the asymmetry between cause and effect. The board of a bank or insurer that may be contributing to systemic risk does not feel the impact of its actions in quite the same way as when such impact is limited only to that entity and its customers. Regulators thus have a rationale to take special action to protect against the possibility of systemic risk.



Network models

One way to assess the possibility of systemic risk is to define a financial market, of banks say, as a network. Each bank is a node in the network and is granted attributes that change over time. These attributes may include debt ratios or capital levels, anything that could contribute to the risk of failure of that entity. Since sound monthly data on each bank is publicly available in South Africa, we can simulate the network at monthly intervals using the attributes of each bank at the time.

Now we assume that the entities are related to one another through the channels of the network. This is entirely appropriate for banks, a little less clear for insurers. We can attach a probability to this relationship, though, simulating the results and testing the impacts on the network of changes to this probability. Then we make assumptions on the extent of the damage to one bank and the nature of the contagion to others. The rest is measurement and iteration.

Dominoes

The process from here is conceptually simple. Let's use a picture. Each bank is represented by a domino. We set up the dominoes on their ends for the first month of the study. We tip one of them over, measuring how many of the other dominoes fall from the cascade. We set them up again. We repeat the simulation on the same bank, say 10 000 times. Then we tip over a different bank and observe the effect, again repeating. Now we change the date, alter the attributes of each bank to match this date and start again. What emerges is a pattern of the tendency of the industry to collapse in response to the failure of one bank, a network effect.

The diagram shows the tendency for disaster over the five years from June 2015. It illustrates the elevated periods of risk that coincide with observable economic stress over the same period, the COVID pandemic at the end, for example. An empirical network-based method helps to assess the risk of contagion and disaster. Rob Rusconi

Illustrations are from my PhD thesis, University of Pretoria, published in 2025.