

## Rare Events: Limiting Their Damage Through Advances in Modeling

Gloria González-Rivera

**PREVIEW** *Rare events such as tsunamis and avalanches often result in severe losses, but such “acts of God” have been beyond the predictive ability of our forecasting models. Advances are being made, however, in forecasting rare economic events. As Gloria tells us, the key is to account for system connectedness to single out the fragile side of an economic network, to quantify the cross-linkages among financial and other institutions, and to perform stress tests that, when credible, will be able to reduce the uncertainty associated with a potentially catastrophic event.*

### INTRODUCTION

The financial crisis of 2008, with its enormous consequences for the world economy, has brought a renewed interest in forecasting rare events. The crisis has triggered questions about the validity and forecasting ability of economic models when confronted with unfamiliar circumstances.

One of the aftershocks has been a crisis of confidence in forecasters and their methods. However, the academic community has responded with unusual energy in exploring new venues of research, revisiting old methods, and opening new paths to include methods from other disciplines. The 9th Workshop of the International Institute of Forecasters, jointly organized with the Federal Reserve Bank of San Francisco and held in September 2012, showcased the latest advances on predicting rare events and modeling systemic and idiosyncratic risk. For a summary, see González-Rivera and colleagues (2012) in *The Oracle*.

While rare events, as the name indicates, occur very infrequently, their consequences tend to be catastrophic. Natural disasters like earthquakes, tsunamis, floods, and avalanches fit this category. In general, they are isolated events and classified as “acts of God.” However, when we consider an economic system, rare events are defined as low-probability, high-magnitude episodes that carry devastating losses, do not for the most part happen spontaneously or in isolation, and

are man-made. Precisely because of these last two characteristics – lack of spontaneity, human causation – there is hope for forecasting economic rare events.

The hope rests on a multidimensional approach to the modeling and monitoring of the many risks in an economic system, which is increasingly hyper-connected. The key notion is *system connectedness*. Episodes that seem rare and idiosyncratic at the outset, like the Lehman bankruptcy in 2008, can quickly become systemic events that jeopardize the stability and functioning of entire economies.

### EXTREME VALUE DISTRIBUTIONS AND QUANTILES

The objective of conventional time series models, e.g., simple and exponential-smoothing mechanisms, seasonal and trend filters, ARIMA models, etc., is to construct a forecast as the expected value (that is, the average) of a future random variable. But with rare events, focusing our forecast on the average outcomes is useless; rather, we need to focus on the low-probability sections of the distribution of possible outcomes. But here is where we find our first problem. Precisely because they are low-probability events, the data is very sparse. In addition, we are forced to contemplate the rare event beyond the range of the available data. In the absence of long historical records, we need mathematical and statistical theories to extrapolate from the available data.

