Discover Dialogue: Geophysicist Didier Sornette

The Dauphin of Disasters

'Is the United States economy sustainable? I don't believe it is.'

By Jocelyn Selim

DISCOVER Vol. 26 No. 12 | December 2005 | Technology

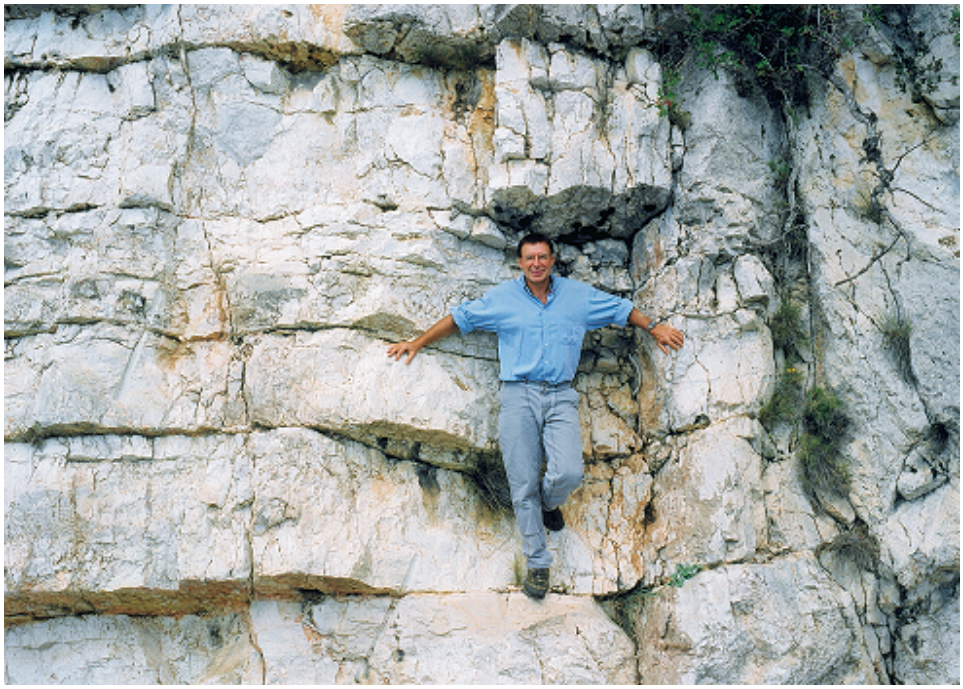

Photo by Jorg Brockmann

Didier Sornette is a professor of geophysics at UCLA and a research director at the National Center for Scientific Research in France. He uses complexity theory to study the myriad causes and effects of catastrophic events, ranging from earthquakes to stock market crashes.

Is there a simple way to explain complexity theory?
S: It's an attempt to understand the organization of all the stuff of interest around us, from galaxies down to bacteria, by understanding the interplay between the positive and negative feedbacks of the various interacting elements. Negative feedback is often obvious—if there are too many rabbits, they eat all the grass, and the population goes down. Positive feedback is much less well appreciated and understood. For example, the more fax machines there are, the more attractive they become because you have more people sharing and extending information. Very simply speaking, positive feedback

amplifies an effect, while negative feedback dampens it.

So how do you decide which elements are important?
S: We use empirical observation. Let's take earthquakes. In the 1930s, when Charles Richter of Caltech got a report of an earthquake, he would drive to it in his old car and make notes about the damage he could see. Then he constructed domains in which equal destruction occurred, and thus he could pinpoint the epicenter. By just repeating that, we developed the idea that earthquakes occur on fault surfaces. Earth's crust is now understood as a complex system of fault surfaces, with rises and drops in stress reflecting the interplay of positive and negative feedbacks operating in the rupture process.

How can you extend that thinking to human behavior?
S: Systems influenced by behavior, like the stock market, are surprisingly simpler to predict because we have an extraordinarily large base of easily accessed and very good quality data. We now know, for example, that if people believe in incorrect things, they can influence events. If everybody believes that the stock market is going to go up, the stock market will go up because it will be pushed up by the buying power, even if this is completely wrong on the basis of fundamental analysis, the gross domestic product, employment numbers, sales, investment value, or the real value of the companies.

Is that how bubbles happen?
S: When prices skyrocket above a reasonable bracket, they become unstable because eventually they must return to a reasonable level. So to me, a crash, for example, is not due to a specific event; it's the result of an instability that has matured over months or years. Think of putting a pen on your finger vertically. You may be able to hold it for a while, but it is a very unstable situation. No matter what you do, it will eventually fall down. Why? You could say it's because there was some wind blowing it on the side. Well, that's true. But the fundamental explanation is that the pen was put in an unstable situation.

Should we use government intervention to stabilize the market?
S: I'll quote Alan Greenspan. In the aftermath of the burst of the new economy bubble in 2000 he said, "We probably should have not done anything because the result of our action would probably have been worse than the result of the bubble and the crash itself." Investors watch Greenspan a lot, right, and if he's calling for a correction, confidence can be lost. As a consequence people will stop spending, and this will give rise to downward-spiraling stock prices. And people might actually overreact, and that's the big problem that any policymaker has to take into account—to discount how people will act.

So it's better to just let things be?
S: From a scientific point of view, it's an extremely interesting problem. It illustrates the interplay effect of positive and negative feedbacks. Southern California and Baja California in Mexico have nearly identical terrains and climate. In Southern California you have no small fires because the policy is to extinguish them immediately. But once in a while you have a huge, devastating, unstoppable fire. That doesn't happen in Mexico because little fires are allowed to burn corridors of biomass and thus develop the negative feedback of natural

barriers. When we get exceptional conditions—dry weather, the Santa Ana wind from the desert, and droughts—I think I'd rather be in Mexico.

Is it too late to put my money into real estate?
S: Stocks and real estate often operate on the "greater fool" theory. Suppose I buy a house that is very expensive, even though real estate prices are way up. I still buy it because I think I will be able to sell it later to a greater fool. It is based on this positive feedback of the appreciation of the price attracting speculators. Stocks can have large fluctuations, too, because of great uncertainty. But a house, unlike a stock, isn't likely to be valued at 10 percent of its price a year after you bought it. It's still land and brick and mortar. A crash is dependent on the health of the economy as a whole and in the confidence of spenders.

Are we in a real estate bubble right now?
S: Yes. Sometime in the first semester of 2006 (and already in the second semester of 2005 in some states), we expect the bubble to transition to another regime. It might be a crash; it might be a plateau. But according to our analysis, the bubble will not continue beyond that.

How do I know you're right?
S: Well, in 2003, we detected a real estate bubble in the United Kingdom, and we correctly predicted the end of the bubble there, around the summer of 2004. But this is only one success, which . . . could be luck. In science, we never know with 100 percent certainty if we're right.

But is your reasoning sound?
S: For a scientist it's not—one success doesn't prove anything. But as scientists we need to stick our necks out a bit; otherwise we lose accountability. We need a track record of wins or losses. And so we publish our findings so there's a track record, and then others may use it and develop it so science can progress.

What do you think of gloom-and-doom predictions for the U.S. economy?
S: These statements are really based not on science but on overinterpreting a very complex system using unscientific methods. There are indeed a certain number of indicators showing that the United States is on an unsustainable path. But the United States also is a very special player, eh? It has the dollar, which is the world's currency. It has the army of the world; it is the Roma Imperial, if you will. So it has a lot of things that are a positive leverage to its clear overspending. Is it sustainable? I don't believe it is. But the correction won't necessarily be a crash.

What else can you analyze with complexity theory?
S: We looked at the thousands of books and all the sales figures and the rankings on Amazon, and we were able to discover that book sales can take off for two reasons. A good review, like one on Oprah, can trigger an avalanche of sales. Or you can have a slow, steady word-of-mouth effect, like the one for Divine Secrets of the Ya-Ya Sisterhood or, more famously, the Harry Potter series, which took off initially by word of mouth among children. We made a model taking into account both

phenomena. We have been able to discover a law—a universal law that works not only for books but for Internet music downloads and other things. It appears to be universal with respect to describing social interactions. It's really a description of the peaks and the decay of fame.

What does knowing that law allow you to do?
S: Even if you take a very, very bad book, let's say, you can always artificially sell it for a while if you advertise it aggressively. That's what politicians do with themselves. Look at movies. A lot of big movies with big names turn out to be extremely bad. For a while the sales will be large, but they will not last.

If we had a big enough computer, could we predict the future?
S: We'd have a better model to predict it. Roughly every two years we double our computing power, and this allows us to put in more and more salient ingredients in our models to get closer and closer to reality. But in doing that we see the horizon receding just as fast, or maybe even faster than our power of computing because the more new ingredients we add, the more complex we see the system is. You know, sometimes you have this impression that the more you know, the less you know.

Website: Didier Sornette