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## Joel Cohen

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Joel E. Cohen is the Abby Rockefeller Mauzé Professor of Populations at the Rockefeller University in New York City. He is also professor of populations at the Earth Institute at Columbia University, and is head of the Laboratory of Populations at Columbia and Rockefeller Universities. Professor Cohen's work in mathematical biology has spanned a wide array of topics, from human population growth to infectious diseases to food webs. He was a MacArthur Foundation Fellow and is a member of the National Academy of Sciences, the board of directors of The Nature Conservancy and the board of trustees of the Population Reference Bureau. He has also served as a neutral expert in federal court cases assessing risks and damages from asbestos and breast implants. We talked with him about different types of risks, and how we can better predict and prepare for them.



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**PwC:** From your perspective as a mathematical biologist who studies the earth, its populations, and its vulnerabilities, are there risks you see that you think most business leaders aren't paying enough attention to?

**JC:** There are some obvious candidates, like global influenza epidemics, which I think are a very serious potential threat to the US economy. Terrorist attacks, including cyber attacks, are risks we should certainly be paying attention to. Some people worry too much about natural disasters—volcanoes, earthquakes, asteroids hitting the earth, etc. If you look at fatalities per year on a global basis, these kinds of events—as well as terrorist attacks—are actually at the low end of the spectrum. At the higher end are things like car accidents and being admitted to a hospital. Medical errors and infectious diseases that you contract in the hospital are major risks to individual lives. With respect to business interests, I think the principal risk we are underestimating is the inadequacy of the US public education system. The US faces stiff competition from very large numbers of increasingly well educated young people in China, India, Latin America and Southeast Asia. They are hungry, ambitious, hardworking, disciplined, and keen to enjoy the same good life that we have become accustomed to.

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**PwC:** You have helped a wide variety of people—in the courts, in public health, in corporations, in government and academia—try to better estimate and understand risk. What have you learned about natural human tendencies when it comes to thinking about risk?

**JC:** Some people seem to believe that it's a linear world out there. But we know it's not a linear world. That was one of the great contributions of Benoit Mandelbrot, whose analysis of financial data showed that the normal distribution just doesn't cut it. There are long-tailed distributions with outlying events that are really impossible to predict with a linear model. On the other end of the spectrum, some people like to frighten themselves with poorly founded assumptions about catastrophic events that could happen in the future. And in between, some people, like some investors, really get it. They live and breathe risk, and as long as they are smarter than they are greedy, they can grasp and use quantified risks quite well.

**PwC:** Do "linear" and "nonlinear" risks call for different kinds of responses?

**JC:** Take something like an influenza pandemic. This is an abrupt, non-linear challenge that is very difficult to predict. The average interval between the last six global pandemics was 28 years (ranging from 6 years to 53 years), and it seems very likely that such an event will happen before mid-21st century. For a risk like this, preparedness is the order of the day. No one knows how severe the next pandemic will be. If I were a corporate executive with a large labor force, I would spend some time thinking about how I am going to operate if a significant fraction of my workforce suddenly gets sick. What will be my priorities for business survival? Do I have back-up? Which positions or people do I need to have backed up in triplicate? What are my essential, core functions? How quickly and completely could I recover afterwards? These are key questions for preparedness.

**PwC:** And what about linear risks?

**JC:** Consider something like the aging of the population. This is a challenge you can actually predict quite well, and precise prediction will pay off. We are coming into a decade of a great increase in the "elderly dependency ratio," or the fraction of people 65+ divided by the fraction of people aged 15 to 64. Since we know that the people who will be 65 in ten years are 55 today, we can predict with some confidence how our population age structure will change over the next decade and beyond. We can predict changes in our labor force and the customer population. If I were a business leader, I would definitely have demographers on my staff.

**PwC:** Any other advice for business leaders on risk?

**JC:** We have to think about and prepare for risks more globally, and this is relevant for business leaders as well as for governments. For example, I have done research on Chagas disease, which is an infectious disease endemic to Latin America. Hundreds of thousands of people come to the US from that region, but until last year, we weren't screening our blood supply for the infection. The disease has also been transmitted through fruit juice. All that has to happen is for an infected bug to fall into a vat, and then that juice gets packaged and sent all over the world. But most of us don't think about the global risks; we only think about the risks to countries in which Chagas disease is endemic. So often we take the wrong approaches to global risks. We make people take their belts off at the airport security checkpoint but we have a very inadequate global public health system to detect outbreaks of infectious diseases around the world. We need to think about those investments that will pay off for us in the long run, that will help us stay prepared. To do that, we have to think beyond our borders.

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