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Spring is in the air. But there is no baseball. There was no March Madness. The Coronavirus has brought regular activities to a sudden stop around the world.

The disruptions caused by COVID-19 are unprecedented in recent years. However, exogenous shocks of global significance are hardly unprecedented in a larger historical context. Older examples include the fall of Rome (476), the Great Bubonic Plague (1347–1351), and the fall of Constantinople (1453). Twentieth Century examples include World War I (1914–1918), the Spanish Flu (1918), the Great Depression (1929–1939), and World War II (1939–1945). Shocks with regional effects are more common. Examples from the past 200 years include: the Great Irish Famine of 1845–1849, the Great Chicago Fire of 1871, the 1883 eruption of Krakatoa, the 1900 Galveston hurricane, the 1906 San Francisco earthquake, the 1973 Oil Crisis, the 1986 Chernobyl nuclear disaster, the 1993 Mississippi River flood, the 9/11 terrorist attack in 2001, the 2004 Indian Ocean tsunami, Hurricane Katrina in 2005, the 2011 Japanese earthquake and Fukushima nuclear disaster, the 2011 Mississippi River flood, Hurricane Sandy in 2012, Hurricane Maria in 2017, and many more. Not all such events produce significant market effects, but most do. And, of course, markets sometimes experience crises without exogenous shocks.

We will not know the ultimate social, economic, and market effects of the Coronavirus for some time, but it is unlikely they will rise to the level of those of the Great Depression or WW II. By comparison to those events, the character of the current disruption is much less severe. Subject to maintaining appropriate social distancing, people can still shop at grocery stores and pharmacies. And, even in areas when other kinds of stores are closed, people can shop for other types of goods online. We are not (as I write this) suffering shortages of ordinary household necessities. By contrast, during WW II, citizens of the US and the UK lived for years under systems of rationing that applied to food and other vital products, such as gasoline. Many of us have heard stories about those times from our parents and grandparents. The Great Depression, which directly preceded the war, was even harder for many households—and for the capital markets.

The 1973 Oil Crisis is a more recent exogenous shock that produced strong effects on society, the economy, and markets. The DJIA dropped 41% from October 1973 to December 1974 (from 987.06 on October 26, 1973 to 587.06 on December 5, 1974) and did not recover until February 1976. The US implemented price controls and odd-even rationing on gasoline.

Events like the Coronavirus and the others mentioned above serve as reminders that each of us is likely to experience *at least* one similar

episode over the course of our careers, perhaps more than one. Accordingly, it would be imprudent to treat such episodes as impossible or irrelevant within the context of managing risk or planning for the long term.

Designers and users of quantitative models must remain sensitive to the limitations of the datasets upon which their models are based. If the development datasets cover only periods of mild or modest stress, the models cannot reasonably be expected to perform with respect to periods of significant, severe, or extreme stress. This is a matter of particular concern in the area of structured finance, where many securities are ostensibly designed to withstand extreme stress. But can they really do so?

The relative infrequency of severe or extreme shocks means that development data for quantitative models may give the false impression that key relationships are stable or that certain phenomena are range-bound. After enough time, we are prone to think that such relationships are immutable or at least predictable in their evolution. For example, looking at California home prices from 1975 through 2003, the largest observed quarterly decline was 2.42% (in 1994Q2). But, from 2004 through 2019, the largest observed quarter decline was 8.25% (in 2008Q2). A development sample from the 1975–2003 period would not prepare us for the kinds of things that actually happened just a few years later.

Strategies based on presumptions of stability or immutable relationships can unravel badly. Unprecedented volatility in the price of silver bankrupted the Hunt brothers in the 1970s. Metallgesellschaft lost $1.5 billion in 1993 when the presumed relationship between spot and future oil prices (higher spot than future, or backwardation) became inverted (contango). Later in the 1990s Long-Term Capital Management (LTCM) lost $4 billion when its quantitative strategy failed. And, more recently, the whole ABS CDO sector imploded in 2007 and 2008, largely because of overreliance on flawed models. Did last year's valuations (and ratings) of CMBS allow for a world where white-collar workers and their employers get accustomed to working from home rather than in office buildings?

In January 2000 I attended a conference at NYU titled "Risk Management: The State of the Art." I had the privilege of hearing a luncheon address by Prof. Stephen Ross titled "Lessons from Forensic Finance." He shared examples of financial "disasters" including the Hunt brothers, Metallgesellschaft, and LTCM. He explained that those episodes offer six lessons for practitioners:

1. Huge price moves do occur, both up and down.
2. For good risk management, it is necessary to consider multiple scenarios, not just the single most-likely one.
3. The process of unwinding (liquidating) big positions is slow and costly.
4. The "agency issue" is real. It can appear whenever employees make company decisions based on their own economic interests rather than on the economic interests of the company. Ross said that he would like to see a whole conference dedicated to the subject of compensation and risk control.
5. Things are sometimes more complicated than they appear.
6. Liquidity can dry up. Moreover, it can be difficult to distinguish a lack of liquidity from a lack of credit (unwillingness of lenders to lend to the firm that needs liquidity).

Prof. Ross asserted that models can be misleading. He added that, in many situations, he preferred to think about things in a simple accounting sense. His bottom line was that practitioners should look at more scenarios—especially negative ones—than they had been. In designing scenarios, practitioners should look beyond recent observations and statistics. Prof. Ross recommended considering all the bad things that have ever happened, everywhere, over extended periods. In essence, he urged looking beyond mere statistics to global economic history.

My own view is more basic. Avoid disappointment by not expecting more of models than they can deliver. They may be highly effective within certain bounds, but much less useful under conditions that are outside their optimal domain. Moreover, we must remain mindful that the world of human affairs, including finance, lacks the strong mathematical consistency of the hard sciences. "Physics envy" by economists and investment professionals is a real danger.

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In fact, even physics has failed to deliver on perfect mathematical consistency. Just ask any physicist trying to reconcile the estimated lifespan of a free neutron as measured by the "bottle" method (878.5 ± 0.8 seconds) with the same quantity measured by the "beam" method (887.2 ± 2.2 seconds). Physicists have so far been unable to explain the discrepancy of nearly 9 seconds. Likewise, physicists struggle to estimate the rate of the universe's expansion, a quantity called the Hubble constant or H_0. According to one type of measurement, based on observations of stars known as Cepheid variables, H_0 is 74.03 ± 1.42 kilometers per second per megaparsec (km/s/Mpc). A second type of measurement, based on the cosmic microwave background radiation, gives a value for H_0 of 67.4 ± 1.4 km/s/Mpc. Physicists consider this discrepancy a "crisis" in cosmology. They cannot even determine how our world actually works, much less create a useful model.

The task of dealing with the real world generally falls to engineering rather than physics. We rely on engineering every day. It is an applied discipline that provides us with everything from running water and electricity to automobiles, computers, cell phones, and airplanes. Delivering running water is not a theoretical exercise. It may use quantitative models but it requires much more. The reality involves dealing with manufacturing tolerances, potentially shoddy workmanship, leaks, corrosion, vibration, thermal expansion, freezing, clogs, and a host of other challenges. Likewise, designing a safe airplane wing takes more than a theoretical assessment of the final product's strength. It takes real-world testing. If you have not already seen it, I recommend watching the YouTube video of the Boeing 777 Wing test (spoiler alert: the wing shatters at 154% of its designed load limit). From the perspective of investment professionals who gravitate toward the quantitative side, striving to emulate engineering rather than physics may be a wise move.

Given that many of us are stuck working in isolation at home, and in the spirit of the preceding comments, I suggest three books to help pass the time while the COVID-19 situation drags on. The first is *Against the Gods: The Remarkable Story of Risk*, by Peter L. Bernstein. He was the founding editor of *The Journal of Portfolio Management*. The book discusses the use of mathematical tools for understanding risk and discusses their limitations. The second book is *The Worst Hard Time: The Untold Story of Those Who Survived the Great American Dust Bowl*, by Timothy Egan. The title says it all. It lends insight into what extreme conditions are like. The third is *The Greatest Generation*, by Tom Brokaw. It provides another window into how our parents' and grandparents' generation met and overcame the extraordinary challenges of the Great Depression and WW II.

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This issue of *The Journal of Structured Finance* opens with an article by Rod Dubitsky. He argues that senior tranches of Collateralized Loan Obligations (CLOs) do not merit the triple-A credit ratings that they receive from the rating agencies. Additionally, he explores the potential for significant systemic risk arising from connections among 1) CLOs, 2) private equity-sponsored companies that borrow via leveraged loans which are then packaged into CLOs, and 3) pension plans that invest in private equity funds. Dubitsky argues that a contraction of available CLO-funded credit to leveraged-loan borrowers could cause many to fail, resulting in both increased unemployment and losses to private equity funds and their pension plan investors.

The issue's second article is by Joseph Pimbley, who is the editor of our sister publication, *The Journal of Derivatives*. Pimbley proposes an improvement to the Hull and White (2004) "loss bucketing" method for estimating the loss distribution of an ABS CDO portfolio. He first presents an algorithm to implement the improved method and then a more concise jump-interpolation implementation.

The third article is by James Leigland. He examines the use of public-private partnerships (PPPs) for financing hybrid infrastructure projects in India. Leigland observes that PPPs for financing infrastructure in developing economies have displayed poor performance. He discusses alternatives to traditional PPP structures that have been tried in India, including government-procured and managed "engineering, procurement, and construction" (EPC) contracts and a type of PPP-EPC mixture known as the hybrid annuity model.

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He notes that other countries can learn from the Indian experience.

The fourth article is by Michael Fabrizio. He discusses the recent decision by the US Court of Appeals for the Fifth Circuit in *Collins v. Mnuchin*. Contrary to the rulings of other US Courts of Appeals, the Fifth Circuit ruled that it was illegal to to sweep GSE profits to the US Treasury (an aspect of their 2008 bailout and the ongoing conservatorships). The case has been appealed to the US Supreme Court.

The last article in this issue is by me. I discuss the mortgage meltdown and how the federal securities laws failed to protect investors in mortgage-backed securities. I argue that the time limit for bringing lawsuits was too short and that the current 3-year time limit should be extended to 12 years.

As always, we welcome your submissions. Please encourage those you know who have good papers or who have made good presentations on structured finance- or project finance-related subjects to submit them to us.

Submission guidelines can be found at https://jsf.pm-research.com/authors. If you have comments or suggestions, you can e-mail me directly at M.Adelson@PageantMedia.com.

REFERENCE

Hull, J. C., and A. D. White. 2004. "Valuation of a CDO and an n-th to Default CDS without Monte Carlo Simulation." *The Journal of Derivatives* 12 (2): 8–23.

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