THOUGHTS FROM THE FRONTLINE

Late Summer Sandpile

By John Mauldin | September 21, 2024

Last week, I said I would continue writing about Michael Gurri's important book, *The Revolt of the Public*. It turns out giving a proper review of not just the book but all of the comments about the book will require more than a few days' writing. I am going through almost 100 pages of new comments and quotes from the book and other essayists.

That being the case, I'm moving up a letter I was planning to share with you on my birthday weekend in two weeks. The story about sandpiles and the financial system may be the most popular letter I've written in the last 25 years. It is one we should all re-read every few years to remind us how change happens slowly, then suddenly. It is actually a good time given that I am talking about an upcoming crisis and some significant changes ahead. The Gurri book explains some of the reasons.

So, without further comment, let's think about that single grain of sand that collapsed the sandpile.

Ubiquity, Complexity Theory, and Sandpiles

I'll be quoting from a very important book by Mark Buchanan called *Ubiquity, Why Catastrophes Happen*. I HIGHLY recommend it if you, like me, are trying to understand the complexity of the markets. The book isn't directly about investing—although he touches on it—it's about chaos theory, complexity theory, and critical states. It's written so anyone can understand—no equations, just easy-to-grasp, well-written stories and analogies.

As kids, we all had the fun of going to the beach and playing in the sand. Remember taking your plastic bucket and making sandpiles? Slowly pouring the sand into ever bigger piles until one side of the pile starts to collapse?

Imagine, Buchanan says, dropping one grain of sand after another onto a table. A pile soon develops. Eventually, just one grain starts an avalanche. Most of the time, it's a small one. But sometimes, it builds up, and it seems like one whole side of the pile slides down to the bottom.

Well, in 1987, three physicists named Per Bak, Chao Tang, and Kurt Wiesenfeld began to play the sandpile game in their lab at Brookhaven National Laboratory in New York. Actually piling up one grain of sand at a time is a slow process, so they wrote a computer program to do it. Not as much fun, but a whole lot faster. Not that they really cared about sandpiles; they were more interested in what are called "nonequilibrium systems."

They learned some interesting things. What is the typical size of an avalanche? After a huge number of tests with millions of grains of sand, they found out there is no typical number. Quoting Buchanan:

> "Some involved a single grain; others, ten, a hundred, or a thousand. Still others were pile-wide cataclysms involving millions that brought nearly the whole mountain down. At any time, literally anything, it seemed, might be just about to occur."

The pile was indeed completely chaotic in its unpredictability. Now, let's read this next paragraph slowly. It is important as it creates a mental image that helps clarify the organization of the financial markets and the world economy.

> "To find out why [such unpredictability] should show up in their sandpile game, Bak and colleagues next played a trick with their computer. Imagine peering down on the pile from above and coloring it in according to its steepness. Where it is relatively flat and stable, color it green; where steep and, in avalanche terms, "ready to go," color it red. What do you see? They found that at the outset, the pile looked mostly green, but that, as the pile grew, the green became infiltrated with ever more red. With more grains, the scattering of red danger spots grew until a dense skeleton of instability ran through the pile. **Here then was a clue to its peculiar behavior: a grain falling on a red spot can, by domino-like action, cause sliding at other nearby red spots.**

> "If the red network was sparse, and all trouble spots were well isolated one from the other, then a single grain could have only limited repercussions. But when the red spots come to riddle the pile, the consequences of the next grain become fiendishly unpredictable. It might trigger only a few tumblings, or it might instead set off a cataclysmic chain reaction involving millions. The sandpile seemed to have configured itself into a hypersensitive and peculiarly unstable condition in which the next falling grain could trigger a response of any size whatsoever." (Emphasis mine. —*JM*)

Something only a math nerd could love? Scientists refer to this as a *critical state*. The term critical state can mean the point at which liquid water changes to ice or the moment a critical mass induces a nuclear reaction. It means something triggered a change in the basic nature of the object or group. Thus (and very casually, for all you physicists), we refer to something being in a critical state (or use the term *critical mass*) when conditions allow for significant change.

> "But to physicists, [the critical state] has always been seen as a kind of theoretical freak and sideshow, a devilishly unstable and unusual condition that arises only under the most exceptional circumstances [in highly controlled experiments]... . In the sandpile game, however, a critical state seemed to arise naturally through the mindless sprinkling of grains."

Thus, they asked themselves, could this phenomenon show up elsewhere? In the earth's crust, triggering earthquakes, in wholesale changes in an ecosystem, or in a stock market crash? "Could the special organization of the critical state explain why the world at large seems so susceptible to unpredictable upheavals?" Buchanan asks.

He concludes in his opening chapter:

> "There are many subtleties and twists in the story... but the basic message, roughly speaking, is simple: **The peculiar and exceptionally unstable organization of the critical state does indeed seem to be ubiquitous in our world.** Researchers in the past few years have found its mathematical fingerprints in the workings of all the upheavals I've mentioned so far [earthquakes, eco-disasters, market crashes], as well as in the spreading of epidemics, the flaring of traffic jams, the patterns by which instructions trickle down from managers to workers in the office, and in many other things.
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> "At the heart of our story, then, lies the discovery that networks of things of all kinds—atoms, molecules, species, people, and even ideas—have a marked tendency to organize themselves along similar lines. On the basis of this insight, scientists are finally beginning to fathom what lies behind tumultuous events of all sorts, and to see patterns at work where they have never seen them before."

Fingers of Instability

So, what happens in our game?

> "[A]fter the pile evolves into a critical state, **many grains rest just on the verge of tumbling, and these grains link up into 'fingers of instability' of all possible lengths**. While many are short, others slice through the pile from one end to the other. So, the chain reaction triggered by a single grain might lead to an avalanche of any size whatsoever, depending on whether that grain fell on a short, intermediate, or long finger of instability."

Now we come to a critical point in our discussion of the critical state. Read this next excerpt with the markets AND our economy and political reality in mind (and this is critical to our understanding of change. Maybe you should read it two or three times.):

> "In this simplified setting of the sandpile, the power law also points to something else: the surprising conclusion that even the greatest of events have no special or exceptional causes. **After all, every avalanche large or small starts out the same way, when a single grain falls and makes the pile just slightly too steep at one point.**
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> "What makes one avalanche much larger than another has nothing to do with its original cause, and nothing to do with some special situation in the pile just before it starts. **Rather, it has to do with the perpetually unstable organization of the critical state, which makes it always possible for the next grain to trigger an avalanche of any size."** (Emphasis mine.)

Now, let's couple this idea with a few other concepts. First, economist Dr. Hyman Minsky showed how stability leads to instability. The more comfortable we get with a given condition or trend, the longer it will persist, and then the more dramatic the correction when the trend fails.

The problem with long-term macroeconomic stability is that it tends to produce unstable financial arrangements. If we believe that tomorrow and next year will be the same as last week and last year, we are more willing to add debt or postpone savings in favor of current consumption. Thus, says Minsky, the longer the period of stability, the higher the potential risk for even greater instability when market participants must change their behavior.

Relating this to our sandpile, the longer a critical state builds up in an economy—or in other words, the more fingers of instability that are allowed to develop a connection to other fingers of instability—the greater the potential for a serious avalanche.

A second related concept is from game theory. The Nash equilibrium (named after John Nash, subject of the Oscar-winning movie *A Beautiful Mind*) is a kind of optimal strategy for games involving two or more players, whereby the players reach an outcome to mutual advantage. If a game has a set of strategies with the property that no player can benefit by changing his strategy while the other players keep their strategies unchanged, then that set of strategies and the corresponding payoffs constitute a Nash equilibrium.

A Stable Disequilibrium

So, we end up in a critical state of what Paul McCulley calls a "stable disequilibrium." We have players all over the world tied inextricably together in a vast dance through equities, debt, derivatives, trade, globalization, international business, and finance. And more recently even in our politics and the global geopolitical order. Each player works hard to maximize their personal outcome and reduce their exposure to fingers of instability.

But the longer the game runs, says Minsky, the more likely it is to end in a violent avalanche, as the fingers of instability have more time to build, and, eventually, the state of stable disequilibrium goes critical.

Go back to 1997. Thailand began to experience trouble. The debt explosion in Asia began to unravel. Russia was defaulting on its bonds. Things on the periphery, small fingers of instability, began impinging on fault lines in the major world economies.

Something that had not been seen before happened. The historically sound and mathematically logical relationship between 29- and 30-year bonds broke down. Then country after country suddenly and inexplicably saw that relationship in their bonds begin to correlate, an unheard-of event. A diversified pool of debt was suddenly no longer diversified. The fingers of instability reached into Long Term Capital Management and nearly brought the financial world to its knees.

No More Business Cycles

One last comment that I picked up over the years. My friend Peter Boockvar actually crystallized this thought, but I think I'm going to make it part of my own liturgy: **We no longer have business cycles; we have credit cycles**. Central banks and governments, not to mention investment banks and investors, are all using credit in formerly unbelievable ways, and I am here to shout that the world is becoming *one massive finger of instability*.

Let's go back to that 1987 mathematical experiment. The simple fact is there are green sand dots all over the world. They represent stability in the global system, which is allowing the fingers of instability to build up in a potentially deadlier way than we have ever seen before.

While we had to deal with a virus-triggered recession, followed by severe inflation and higher interest rates, thankfully the economy remained (more or less) stable. Yes, the world looks different in 2024 than it did in 2019, but we avoided global economic catastrophe.

We take comfort from the stability we see around us. Corporate profits are up. The S&P 500 touched a new all-time high this week. We are greeted every day with some amazing new technological innovation that changes everything in some industry. Living standards keep rising.

Minsky tells us stability breeds instability. That sandpile experiment, as simple as it seems now, shows that the longer the stability lasts, with the fingers of instability connecting in hidden and unknown ways, the greater the avalanche will be.

I suggest you read at least the first half of Nassim Nicholas Taleb's book, *Antifragile*. Here are three lessons that will show you what it means to be antifragile:

1. Fragile items break under stress; antifragile items get better from it.

2. In order for a system to be antifragile, most of its parts must be fragile.

3. Antifragile systems work because they build extra capacity when put under stress.

This is a great way to explain the sandpile game in economic terms. Economic sandpiles that have many small avalanches never have large fingers of stability and massive avalanches. The more small, economically unpleasant events you allow, the fewer large and, eventually, massive fingers of instability will build up.

Efforts by regulators and central bankers to prevent small losses actually *create* the large fingers of instability that bring down whole systems and spark global recessions. And, increasingly, giant debt and the unfunded liabilities of government promises are becoming the most massively unstable finger.

In the next crisis, things that should be totally unrelated will suddenly become intertwined. The correlations of formerly unrelated asset classes will all go to one at the absolute worst time. Panic and losses will follow. Governments will try to stem the tide, perhaps appropriately so, but eventually, the markets have to clear.

There is a surprising but critically powerful thought in that computer model from decades ago: **We cannot accurately predict when the avalanche will happen.** You can miss out on all sorts of opportunities because you see lots of fingers of instability and ignore the base of stability. And then you can lose it all at once because you ignored the fingers of instability.

You need your portfolios to both *participate* and *protect*. Don't blindly buy index funds and assume they will recover as they did in the past. This next avalanche is going to change the nature of recoveries as other market forces and new technologies change what makes an investment succeed.

I cannot stress that enough. Don't get caught in a buy-and-hold, traditional 60/40 portfolio. Don't walk away from it. *Run* away.

Cautious optimism is always the long-term winner. Always. But a buy-and-hold portfolio in today's world is neither cautious nor optimistic. Hope is not a strategy. That's precisely what a buy-and-hold portfolio is.

Birthdays and Books

I don't really celebrate birthdays unless it's a big number, and 75 seems like a big number to me. It comes at a time when I'm also doing a lot of personal reflection about the future. I will have all of my 8 kids, their partners, and almost all of my nine grandkids, plus a lot of friends flying in from around the country plus local friends I've made here in Dorado Beach. Not too large, so I will have some time to meet with everybody.

My actual birthday is October 4, and that will be a quiet celebration with family and a few friends who have been flying in from around the country. Simple fare, hamburgers and hotdogs, enjoying my grandkids playing in the pool, lots of laughter and good conversation. I will likely spend the day before making cakes. My mother always made a very special banana nut cake and what I truly think is one of the best carrot cakes I've ever had. I will make enough for both parties.

The bigger party will be October 5. The food will be more elaborate and simply watching my friends, many of whom will be meeting for the first time, interact with each other will give me great pleasure. It feeds my soul. Not to mention the conversations I will have. We will start early and probably go later than we should.

My publishing partners are coming in, along with a number of longevity experts, and we will make some videos you will see in the not-too-distant future. Some of the progress on the longevity front is simply about increasing your healthspan, but some of it is seriously going to impact our lifespans in a positive way.

The first generations to not die from old age are alive today. While my personal chance may be a small percentage (as I recognize, apart from some of my more hopeful moments), it is a percentage that wasn't there for past generations. We (humanity) are lengthening telomeres in multiple studies and locations. Some other work with stem cells is absolutely staggering in its implications. Genetically, I should make it into my 90s. Is 15 years enough? I guess we'll all have to just stay tuned. I agree with my friend Ray Kurzweil, who says, "The goal is to live long enough to live forever." There's a whole universe to explore.

I see your eyes rolling. And you are almost assuredly correct. But "almost" is a chance I intend to grasp if I can.

With that, as my dad used to say, it's time to head to the wagon yard. He was born in 1910. His father was born in 1859. Dad as a young man hitched up mules to go to downtown Fort Worth every week or so. At the end of the day, they would literally head to the wagon yard.

Have a great week and enjoy your friends and family as much as you can.

Your seeing fingers of instability everywhere analyst,

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