



How Change Happens

By John Mauldin | August 17, 2012

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“To trace something unknown back to something known is alleviating, soothing, gratifying and gives moreover a feeling of power. Danger, disquiet, anxiety attend the unknown – the first instinct is to eliminate these distressing states. First principle: any explanation is better than none... The cause-creating drive is thus conditioned and excited by the feeling of fear ...”

– Friedrich Nietzsche

“Any explanation is better than none.” And the simpler, it seems, in the investment game, the better. “The markets went up because oil went down,” we are told. Then the next day the opposite relationship occurs, and there is another reason for the movement of the markets. But we all intuitively know that things are far more complicated than that. As Nietzsche noted, dealing with the unknown can be disturbing, so we look for the simple explanation.

“Ah,” we tell ourselves, “I know why that happened.” With an explanation firmly in mind, we now feel we know something. And the behavioral psychologists note that this state actually releases chemicals in our brain that make us feel good. We literally become addicted to the simple explanation. The fact that what we “know” (the explanation for the unknowable) is irrelevant or even wrong is not important for the chemical release. And thus we look eagerly for reasons.

And that is also why some people get so angry when you challenge their beliefs. You are literally taking away the source of their good feeling, like drugs from a junkie or a boyfriend from a teenage girl.

Thus we reason that the NASDAQ bubble happened because of Greenspan. Or that it was a collective mania. Or any number of things. Just as the proverbial butterfly flapping its wings in the Amazon triggers a storm in Europe, we may conclude that a borrower in Las Vegas triggered the subprime crash.

Crazy? Maybe not. Today we will look at what complexity theory tells us about the reasons for phenomena as apparently diverse as earthquakes and the movement of markets. Then we’ll look at how New Zealand, Fed policy, gold, oil, and that lone investor in St. Louis are all tied together in a *critical state*.

Of course, how critical and which state are the issues.

This is an encore appearance of the letter that is clearly the most popular one I have ever written, updated with a few thoughts from recent times (it was also part of a chapter in *Endgame*). Numerous reviewers have stated that this one letter should be read every year. As you read, or reread, I'll be enjoying a week off. I have gone off to a secret location to relax and get away, all by my lonesome, which is something I have really not done for years. It will be interesting to see if I can adjust to all the peace and quiet, but so far I am coping quite well. And now, let's think about *ubiquity*.

Ubiquity, Complexity Theory, and Sandpiles

We are going to start our explorations with excerpts from a very important book by Mark Buchanan, called *Ubiquity: Why Catastrophes Happen*. I HIGHLY recommend it to those of you who, like me, are trying to understand the complexity of the markets. Not directly about investing, although he touches on it, it is about chaos theory, complexity theory and critical states. It is written in a manner any layman can understand. There are no equations, just easy to grasp, well-written stories and analogies. www.amazon.com/ubiquity.

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

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 is a small one, but sometimes it builds on itself 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 Weisenfeld began to play the sandpile game in their lab at Brookhaven National Laboratory in New York. Now, 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 that there is no typical number. "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 piles were indeed completely chaotic in their unpredictability. Now, let's read this next paragraph from Buchanan slowly. It is important, as it creates a mental image that may help us understand the organization of the financial markets and the world economy. (emphasis mine)

"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."

The Critical State

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 water would go to ice or steam, or the moment that critical mass induces a nuclear reaction, etc. It is the point at which something triggers a change in the basic nature or character 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 there is the opportunity 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, or as wholesale changes in an ecosystem – or as a stock market crash? "Could the special organization of the critical state explain why the world at large seems so susceptible to unpredictable upheavals?" Could it help us understand not just earthquakes, but why cartoons in a third rate paper in Denmark could cause world-wide riots?

Buchanan 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. 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."

Now, let's think about this for a moment. Going back to the sandpile game, you find that as you

double the number of grains of sand involved in an avalanche, the probability of an avalanche becomes 2.14 times more likely. We find something similar in earthquakes. In terms of energy, the data indicate that earthquakes become four times less likely each time you double the energy they release. Mathematicians refer to this as a “power law,” a special mathematical pattern that stands out in contrast to the overall complexity of the earthquake process.

Fingers of Instability

So what happens in our game? “...after 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. Again, read this with the markets in mind (again, emphasis mine):

“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.** 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.**”

Now, let’s couple this idea with a few other concepts. First, Hyman Minsky (who should have been a Nobel laureate) points out that stability leads to instability. The more comfortable we get with a given condition or trend, the longer it will persist and then when the trend fails, the more dramatic the correction. 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 that 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.”

We Are Managing Uncertainty

Or, maybe a series of smaller shocks lessens the long reach of the fingers of instability, giving a paradoxical rise to even more apparent stability. As the late Hunt Taylor wrote:

“Let us start with what we know. First, these markets look nothing like anything I’ve ever

encountered before. Their stunning complexity, the staggering number of tradable instruments and their interconnectedness, the light-speed at which information moves, the degree to which the movement of one instrument triggers nonlinear reactions along chains of related derivatives, and the requisite level of mathematics necessary to price them speak to the reality that we are now sailing in uncharted waters....

“I’ve had 30-plus years of learning experiences in markets, all of which tell me that technology and telecommunications will not do away with human greed and ignorance. I think we will drive the car faster and faster until something bad happens. And I think it will come, like a comet, from that part of the night sky where we least expect it. This is something old.

“I think shocks will come, but they will be shallower, shorter. They will be harder to predict, because we are not really managing risk anymore. **We are managing uncertainty** – too many new variables, plus leverage on a scale we have never encountered (something borrowed). And, when the inevitable occurs, the buying opportunities that result will be won by the technologically enabled swift.”

Another way to think about it is the way Didier Sornette, a French geophysicist, has described financial crashes in his wonderful book *Why Stock Markets Crash* (the math, though, was far beyond me!). He wrote, “[T]he specific manner by which prices collapsed is not the most important problem: a crash occurs because the market has entered an unstable phase and any small disturbance or process may have triggered the instability. Think of a ruler held up vertically on your finger: this very unstable position will lead eventually to its collapse, as a result of a small (or an absence of adequate) motion of your hand or due to any tiny whiff of air. The collapse is fundamentally due to the unstable position; the instantaneous cause of the collapse is secondary.”

When things are unstable, it isn’t the last grain of sand that causes the pile to collapse or the slight breeze that causes the ruler on your fingertip to fall. Those are the “proximate” causes. They’re the closest reasons at hand for the collapse. The real reason, though, is the “remote” cause, the farthest reason. The farthest reason is the underlying instability of the system itself.

A fundamentally unstable system is exactly what we saw in the recent credit crisis. Consumers all through the world’s largest economies borrowed money for all sorts of things, because times were good. Home prices would always go up and the stock market was back to its old trick of making 15% a year. And borrowing money was relatively cheap. You could get 2% short-term loans on homes, which seemingly rose in value 15% a year, so why not buy now and sell a few years down the road?

Greed took over. Those risky loans were sold to investors by the tens and hundreds of billions of dollars, all over the world. And as with all debt sandpiles, the fault lines started to appear. Maybe it was that one loan in Las Vegas that was the critical piece of sand; we don’t know, but the avalanche was triggered.

You may not remember this, but I was writing about the problems with subprime debt way back in 2005 and 2006. But as the problem actually emerged, respected people like Ben Bernanke (the chairman of the Fed) said that the problem was not all that big and that the fallout would be “contained.” (I bet he wishes he could have that statement back!)

But it wasn’t contained. It caused banks to realize that what they thought was AAA credit was actually a total loss. And as banks looked at what was on their books, they wondered about their fellow banks. How bad were they? Who knew? Since no one did, they stopped lending to each other. Credit simply froze. They stopped taking each other’s letters of credit, and that hurt world trade. Because banks

were losing money, they stopped lending to smaller businesses. Commercial paper dried up. All those "safe" off-balance-sheet funds that banks created were now folding (what my friend Paul McCulley first labeled as the Shadow Banking System). Everyone sold what they could, not what they wanted to, to cover their debts. It was a true panic. Businesses started laying off people, who in turn stopped spending as much.

As I read through this again, I think I have an insight. It is one of the reasons we get "fat tails." In theory, returns on investment should look like a smooth bell curve, with the ends tapering off into nothing. According to the theoretical distribution, events that deviate from the mean by five or more standard deviations ("5-sigma events") are extremely rare, with 10 or more sigma being practically impossible – at least in theory. However, under certain circumstances, such events are more common than expected; 15-sigma or even rarer events have happened in the world of investments. Examples of such unlikely events include Long Term Capital in the late '90's and any of a dozen bubbles in history. Because the real-world commonality of high-sigma events is much greater than in theory, the distribution is "fatter" at the extremes ("tails") than a truly normal one.

Thus, the build-up of critical states, those fingers of instability, is perpetuated even as, and precisely because, we hedge risks. We try to "stabilize" the risks we see, shoring them up with derivatives, emergency plans, insurance, and all manner of risk-control procedures. And by doing so, the economic system can absorb body blows that would have been severe only a few decades ago. We distribute the risks and the effects of the risk throughout the system.

Yet as we reduce the known risks, we sow the seeds for the next 10-sigma event. It is the improbable risks that we do not yet see that will create the next real crisis. It is not that the fingers of instability have been removed from the equation, it is that they are in different places and are not yet visible.

A second related concept is from game theory. The **Nash equilibrium** (named after John Nash, he of *The 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 there is a set of strategies for a game with the property that no player can benefit by changing his strategy while (if) 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" of this game from all over the world tied inextricably together in a vast dance through investment, debt, derivatives, trade, globalization, international business and finance. Each player works hard to maximize their own personal outcome and to reduce their exposure to "fingers of instability."

But the longer we go on, asserts Minsky, the more likely and violent an "avalanche" is. The more the fingers of instability can build. The more that state of stable disequilibrium can go critical on us.

Go back to 1997. Thailand began to experience trouble. The debt explosion in Asia began to

unravel. Russia was defaulting on its bonds. (Astounding. Was it less than ten years ago? Now Russia is awash in capital. Who could anticipate such a dramatic turn of events?) Things on the periphery, small fingers of instability, began to impinge on fault lines in the major world economies. Something that had not been seen before happened: the historically sound and 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.

If it were not for the fact that we are coming to the closing innings of the Debt Supercycle, we would already be in a robust recovery. But we are not. And sadly, we have a long way to go with this deleveraging process. It will take years.

You can't borrow your way out of a debt crisis, whether you are a family or a nation. And, as too many families are finding out today, if you lose your job you can lose your home. People who were once very creditworthy are now filing for bankruptcy and walking away from homes. All those subprime loans going bad put huge numbers of homes back onto the market, which caused prices to fall on all homes, which caused an entire home-construction industry to collapse, which hurt all sorts of ancillary businesses, which caused more people to lose their jobs and give up their homes, and on and on. The connections in the housing part of the sandpile were long and deep.

It's all connected. We built a very unstable sand pile and it came crashing down, and now we have to dig out from the problem. And the problem was too much debt. It will take years, as banks write off home loans and commercial real estate and more, and we get down to a more reasonable level of debt as a country and as a world.

Bond markets require confidence above all else. If Greece defaults, then how far away is Spain or Japan? (We now see that Spain is not all that far!) What makes the US so different, if we do not control our debt? As Reinhart and Rogoff show, when confidence goes, the end is very near. And it always comes faster than anyone expects. Bang! there goes the sandpile.

The global financial system is all connected. Tiny Greece and now larger Spain but soon Italy and even France (!) can make a huge difference in places far removed from Europe, just as our subprime debt created a crisis all over the world. The world financial system allowed too much risk to be taken on, and then spread that risk far and wide through fancy new financial engineering and securitizations. Many investors and pension funds thought that by buying a lot of different types of securities they were diversifying their risk, when in fact the same connected risk ran through almost everything.

Investments that are normally not correlated will again show a high degree of correlation, as they did during the recent crisis, just when we need that diversification of risk to help us. There is no reason to think it will be all that much different in the next crisis period. Investing is not easy.

Getting Older and Other Happy Thoughts

We celebrated my Mother's 95th birthday last Tuesday. 140 people showed up to a nice reception and dinner. Both my father and mother were the youngest of 11 kids, so all my uncles and aunts have gone on, and even my direct cousins who were there were in their mid-80s. I am the "young" lad at

almost 63. But mother has friends from many generations (through her Sunday school class of the last 30 years), who all showed up, as well as all the grandchildren and great-grandchildren and other remaining relatives.

I saw pictures of my mom that I had never seen. She was in Germany right after the war and traveled around Europe. Evidently my brother found the hidden box. She was one of the original shutterbugs and kept huge boxes of pictures, many of which she has already put into books for us kids.

I already knew she was a major babe back then, but I had never seen her with pictures of anyone besides my Dad. I am going to have to ask her about that. Who were those young bucks? She had about 300 mostly color postcards from Europe that she had sent back home and then retrieved, documenting her travels everywhere. This was an age before Facebook, when a postcard from the road was the only way to really communicate. It made me reflect on how times change, but the drive to communicate and stay in touch stays the same.

Watching the various generations interact was interesting. Both mother and dad basically stopped moving as they got older, and that lost mobility defined their existence. While mother is mentally as sharp as ever, she is confined to a small area and a few trips here and there. She was content to sit and read and watch TV (her religious shows and the news), and we simply could not get her to exercise. Then again, her life has not been easy. Mine is a dream compared to what she lived through.

But many in the Boomer generation (that would be me) remain far more active as they age. That lifestyle, combined with advances in medicine and health care, is letting us live longer and healthier.

I quit drinking (cold turkey) almost exactly a year ago, and I must report that I feel much better, which kind of surprises me. The improvement was gradual (nothing dramatic), but as I look back there is a qualitative difference. As someone quipped, you are allotted 50,000 gallons of alcohol in one life, and I had hit my limit.

Still, the last six months have been hellacious with travel, as my schedule simply got absurd, and most of the time I was either booked with meetings or had deadlines. I must confess that my typical 3-4 times a week in the gym was the victim of that schedule. And THAT I can feel. Talk about bad choices.

My mother's birthday party reminded me (among a lot of other things) that I cannot take my body for granted, and that I am way too stiff for a (relatively) young man. That will change. This week, I simply got on a plane to a resort with a good gym and spa and will spend five days starting a routine to get back to some semblance of whatever counts as being "in shape" at 63. This time with more stretching and lighter weights/more reps. A man has to know his limitations, and mine will get much more confining if I don't make staying in shape a priority. And when I am on the road, gym time will get scheduled first. My health is not something I want to take for granted.

All the check-ups and blood work, vitamins, supplements and eating healthy will not help if I do not do the work to maintain my health. Getting older is much better than the alternative, but I have no desire to go gently into that good night. I hope to be writing to you in 20 years. It is just too much fun to

not keep it up.

And you need to stay in shape so you can be reading me in 20 years. I need all my million best friends to stay with me! So get with the program!

And with that thought, let me hit the send button. The gym calls, and some good books (non-finance!), and a ton of little things I have put off and want to do are on tap for this weekend. I am going to live on the edge and learn to put music on my iPhone without having to ask a friend or one of my kids.

Have a great week. Brother Iron and Sister Steel are calling.

Your wondering how long I will be sore analyst,

John Mauldin

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