



## Chaos Theory

Once per quarter investment professionals from across PIMCO's global offices gather in Newport Beach for our Economic Forum. These sessions have been the foundation of PIMCO's investment process for years; we debate and update our short-term and long-term views for the global economy, and, from that, for individual asset classes, such as government bonds, corporate bonds, mortgages and stocks. Last month we gathered for our December Forum and the topic that dominated the discussion, as it has in recent quarters, was the fate of the euro. Will the eurozone break up? Will European governments impose extreme, deflationary austerity to control their deficits? Will the ECB monetize the region's debts and risk inflation in order to preserve the common currency?

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This is a debate that has raged within PIMCO for quite a while. There is a wide range of opinions, each supported by relevant precedents and sound economic reasoning. Yet despite our intense focus, we don't know the answer with certainty.

Here in America we too face a similar question, though markets are not currently demanding an immediate answer. For the last few decades America has fueled its economic growth by borrowing and consuming, and, in doing so, has racked up large, unsustainable debt. Families that take on too much debt must eventually cut spending, either to pay back loans, or at least because banks stop lending them money. They are eventually forced into some combination of austerity and default. But countries with their own currencies have a choice: 1) austerity-induced deflation, or 2) print money and eventually trigger inflation, which makes their debts easier to pay off, while robbing creditors of the real return they were promised. Will we find the political will to cut spending? Or will we continue running large deficits? Will the Federal Reserve resume quantitative easing, in effect monetizing our debts? Will it unintentionally trigger inflation?

Listening to my colleagues make their arguments during the Forum, I was taken back to my days fifteen years ago when I was an engineering graduate student at the University of Illinois. You may wonder what a debate about the global economy has to do with engineering. It reminded me of one of my favorite classes: nonlinear systems – the study of natural and man-made systems that, at times, behave very oddly. Allow me to explain.

## Western societies are facing a seemingly minor choice, but that choice will lead to vastly different endpoints for the global economy and for asset prices.

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Most systems we interact with every day are linear: if you change an input to the system by a small amount, the output will also change by a small amount. Think about driving to work: if you leave your house 10 minutes early, you will usually arrive about 10 minutes early. If you turn up the flame on a stove a little, the pot of water will heat a little faster.

But some systems, under certain conditions, behave very differently. These systems are said to have “sensitive dependence on initial conditions” – very small changes of the inputs can lead to enormous variations of the output. Mathematicians have given these systems the label of being “chaotic” and experts in the field are called “chaoticians.” (The term “chaotician” always struck me as ridiculous. Could you imagine introducing yourself this way?) The weather is the best example of a real-life chaotic system. Predicting the weather beyond a few days is impossible because minor variations lead to large changes in the future. Go back to the driving example: if you leave 10 minutes late, rather than 10 minutes early, you might hit rush hour, and the extra 10 minutes ends up costing you an hour. Chaos theory describes the conditions under which a system changes from linear and smooth to highly nonlinear and violent, where minor changes to the inputs will lead to enormous variations of the output.

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In a “normal” economic environment investors debate a narrow range of outcomes: will the U.S. grow by 2.8% or 3.2%? Will inflation remain at 2.0% or climb to 2.3%? Debating a future of inflation vs. deflation is radically new territory for investors. The chaotic nature of the choice facing societies is whipsawing equity markets and dominating bottom-up factors.

While we don’t know with certainty which path societies will choose, we can identify a few potential outcomes and make reasoned assessments of what they mean for the economy and for equities:

### 1. Austerity and deflation

Borrowing money to consume allows families and societies to live beyond their means – for a time. Once the debt accumulation has run its course, reality has to set back in. For a family that may mean getting rid of a second car, dining out less often or cuts which are far more painful. It necessarily means consuming less, and to the extent that consumption equates to

standard of living, it likely also means a reduced living standard. Societies face a similar challenge. The U.S. and parts of Europe have enjoyed exaggerated living standards enabled by borrowing from our future. Now that creditors are warning us they won’t let this continue forever, governments may reach consensus to cut spending and/or increase taxes to bring budgets into balance. Whatever the mix, by definition this likely means lower economic growth and perhaps a lower level of overall economic activity until debts are worked off and real growth is restored. Deflation runs the risk of creating a vicious cycle, where prices fall, causing wages to fall, causing spending to fall, causing prices to fall further. This is a lower risk for a growing population such as in the United States, whereas Japan continues to suffer from such stagnation today. Europe’s demographics are much worse than America’s. The outlook for equities in this environment is negative in the short run and potentially very negative in the long run if a deflationary cycle kicks off. Corporate earnings at some point must be linked to economic growth, and stock prices represent the present value of a future stream of earnings. In a deflationary environment cash will be king – because your purchasing power will increase by just sitting on the sidelines.

### 2. Explicit default

The scenario of governments not paying back their creditors is extremely unlikely for countries that have their own currencies. Why default on your debt, which would trigger a crisis of confidence in your economy, when you can simply print more money? Of course, unpredictable politics can make the unthinkable possible, as we came dangerously close to seeing this summer with Washington’s debt ceiling debacle. In Europe it is likely some smaller countries, such as Greece, will default on their debt. They simply have taken on more debt than their economies can reasonably hope to pay back. And they don’t have their own currency, so printing drachma is not an option. It is hard to imagine a scenario where an explicit default would be good for equities. Just how bad depends on the size of the country defaulting and the extent of the preparations put in place to minimize the damage. For example, if countries have capitalized their banks to withstand the losses from a Greek default and the ECB funds Italy and Spain so they are not at risk of contagion, the impact to equities should be more muted. An uncontrolled default, or a default of a larger country would be very bad for risk assets and could trigger a deflationary spiral described above.

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### 3. Mild inflation

Mild inflation is the goldilocks scenario: central banks print money to help fund governments while they employ structural reforms to make their economies more competitive and generate long-term growth. Such structural reforms take time to produce results, often many years. Printing money provides governments with that time while, in theory, reducing the sacrifices citizens must make, and the inflation that usually follows makes the fixed debt stock easier to service, because prices (and hence taxes) increase. It often results in a falling currency, which makes exports more competitive. It is easy to see why countries with their own currencies usually choose inflation as the preferred response to overwhelming debt. Although creditors suffer because the purchasing power they were expecting has been reduced, society has to make fewer hard choices and can continue to enjoy its exaggerated standard of living until the pro-growth economic reforms come to the rescue. In a scenario of mild inflation, equities should do well. Prices are contained, the economy functions and corporate profits should continue increasing. Of course, if policymakers do not use this time to implement real economic reforms, which can still be painful for certain constituencies, mild inflation doesn't solve anything. It just delays the necessary day of reckoning.

### 4. Runaway inflation

The danger of mild inflation is that it may not remain mild. Inflation is driven by expectations, the collective beliefs of what the future holds that reside in the minds of millions of people. If people expect prices to go up, they will demand higher wages so they can maintain their standard of living. This will increase the cost of labor, pushing the cost of goods higher. A vicious cycle of inflation can take hold as prices climb higher and higher. The U.S. suffered from double-digit inflation in the 1970s, and in an extreme case, Germany suffered from hyper-inflation following World War I. Runaway inflation is devastating because an economy loses its anchor. People are afraid to hold cash because their purchasing power drops rapidly and so they must hoard real assets. Interest rates soar causing investments to plummet. Central bankers are generally afraid of attempting to induce mild inflation for fear they may nudge expectations more than they hoped. Nudging the collective beliefs of millions of people is an inexact science. The Federal Reserve is cautiously experimenting with its expectations-nudging-arsenal with its recent communication innovations. Runaway inflation would be

very bad for most risk assets and equities in particular because of the devastating effects on real economic growth and the increases in costs of production and of capital. A loss of faith in paper currencies would mean gold and real assets would likely be king.

### 5. Miraculous growth

A list of potential solutions to our unsustainable debt load would be incomplete without including a high growth scenario. It is true there could be a major breakthrough in, for example, energy technology that spurs extraordinary economic growth, which would drive tax revenues higher and enable governments to pay down their debt without asking their citizens to give up their exaggerated living standards. In such a scenario, equity returns would likely be very strong, especially for the sector enjoying the innovation. The technology sector in the 1990s was an example. However, such a scenario today is low-probability. We invest based on what we think is likely to happen, rather than what we would like to happen. Policymakers can't count on a growth miracle and neither can investors. And don't forget the bumper tax revenues of the 1990s actually led to *increased* government spending in some cases when politicians wrongly assumed the increased tax revenues would last forever.

While the expected value of two equally possible outcomes, 0 and 1, is 0.5, there is zero chance the outcome will actually be 0.5. It will either be 0 or 1. Based on the level of the stock market today, with a price to earnings ratio of about 13x in the developed world and 11x in the emerging economies, equity investors seem to be pricing in a combination of these outcomes, with the largest weighting going to the goldilocks, mild inflation scenario. But the market's large daily swings reflect jumps back and forth as investors update the probabilities of these very different destinations.

I believe societies will in the end choose inflation because it is the less painful option for the largest number of its citizens. I am hopeful central banks will be effective in preventing runaway inflation. But it is going to be a long, bumpy journey until the destination becomes clear. This equity market is best for long-term investors who can withstand extended volatility. Day traders beware: chaos is here to stay for the foreseeable future.

**A word about risk: Past performance is not a guarantee or a reliable indicator of future results.** Equities may decline in value due to both real and perceived general market, economic and industry conditions. There is no guarantee that these investment strategies will work under all market conditions, or are suitable for all investors, and each investor should evaluate their ability to invest long-term, especially during periods of downturn in the market.

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