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Energy, Debt, and Spaceship Earth*

By

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When Thomas Jefferson wrote the Declaration of Independence, about 95% of our population was farmers, including Jefferson himself. That means only 5% of Americans were dependent on the muscles of other men or beasts for their daily food supply. Today, 100% of us – including the 2% who actually *are* farmers – are utterly dependent upon fossil fuel energy, and the machines it fuels, for the cultivation, fertilization, processing and distribution of our daily food supply. What we have done – thanks to fossil fuels – is *accelerate* energy consumption by subcontracting out the job of food production to machines, ultimately freeing the vast majority of our population to become, in essence, professional shoppers.

Some people call this situation “progress.” Others might be tempted to compare it to the event that befell Apollo 13, America’s only failed moon mission in 1970.

Apollo 13 and Energy Conservation in a Closed System

Energy-wise, and food-wise, the Apollo 13 spacecraft represented a closed system. That is, it received no significant energy inputs from outside its own self-contained life support system. All of its environmental systems ran on electricity that was produced from two fuel cells. They, in turn, were powered by liquid hydrogen and liquid oxygen, of which the spacecraft possessed a fixed quantity. Thus, its energy resources, for both man and machine, were finite and non-renewable.

As Apollo 13 hurtled toward the moon, the astronauts were conducting a routine procedure that called for them to pressurize one of the liquid oxygen tanks. Minutes later, the astronauts felt a shudder. Then the lights dimmed out. They were two hundred thousand miles

from Earth. Command pilot Jim Lovell made his famous radio call: *OK, Houston...we've had a problem*. This, as it turned out, proved to be a magnificent understatement.

Due to an engineering error, Apollo's liquid oxygen tank had exploded, ripping out not only its own fuel cell piping, but that of the redundant system, as well. But since NASA personnel assumed no explosion could possibly have occurred, they did not take proper measures to conserve what fuel was left, and it all drained away into space. Now the astronauts were marooned on a dark spacecraft, far off-course, with no heat, no full-time computer, and little hope of ever returning to Earth.

The only source of energy now available to their closed system was the electricity stored in the battery of the Lunar Excursion Module. But using it would require jury-rigging the electrical system to flow in a direction opposite to that originally intended. So NASA brought together every single engineer that had designed the Apollo electrical system for an all-night session to brainstorm the problem. In the morning the NASA flight director popped the question: Would reverse-wiring the spacecraft work? But the men who had designed the system did not know. Either it would work without a hitch, they said, or it would catastrophically melt down the electrical system. Even if it did work, energy conservation measures enacted aboard the spacecraft would have to be austere.

Having no alternative, Mission Control had the astronauts wire the battery up backwards. The switch was thrown. The lights came back on. Eventually Lovell flew Apollo back home safely, but only by the slimmest of margins, and only after having spent days in a dark spacecraft, in ambient temperatures dipping toward freezing. When Apollo landed, it had only enough energy remaining to power a flashlight for about an hour.

Spaceship Earth, Energy, and Economic Growth

Like Apollo 13, the Earth is a space ship, only with seven billion astronauts aboard, all of them energy consumers. And, like Apollo 13, our stored energy is depleting at an alarming rate. We know that humans have burned through about half of all the readily available conventional petroleum reserves on the planet. But we also know the RATE at which we use this limited fuel

supply has not remained constant, but has been increasing exponentially – though it now appears that annual world production of conventional crude oil peaked in 2005.

Consider this: 95% of all the petroleum humans have used so far has been used up since construction began on our interstate highway system in 1956. Another way to state the same statistic is to note that one quarter *of all the oil there ever was* has been consumed in the last 20 years. Simple arithmetic reveals that, at current rates of consumption (2.7 billion barrels/year), the remaining conventional oil (1.2 trillion barrels) will last approximately 45 years.

But might we find more petroleum stashed away in some secret tanks aboard the Spacecraft Earth? Without doubt we will. We have been finding “secret” stashes like that for decades – such as the current increase in non-conventional (and thus expensive) shale oil and deep offshore crude production in the last few years. But since the 1960s we have been discovering less and less cheap, conventional petroleum, despite fantastic improvements in exploration technology. The conventional crude oil the world’s geologists presently discover during the course of a year, the rest of us consume in about three months.

Two Big Problems: Energy Consumption and Economic Growth

But remember, the 45-year supply figure is based on *present rates* of consumption – that is, on a presumption of a steady-state, no-growth world economy. There are two Big Problems associated with this presumption.

Big Problem #1: Energy Consumption. The number of astronauts on Spaceship Earth increases by over 75 million per year. Imagine a child entering pre-kindergarten today. The world will have added population nearly equal to that of China by the time that child graduates from high school. In addition, tens of millions of additional people every year will be expecting to have the same things all Americans expect to possess: nice houses, flat screen TVs, new automobiles, good jobs, paid vacations, and more of everything they see advertised on those hi-tech TVs they just bought. So figures based on the *present rate* of consumption won’t work.

Let’s “crunch some numbers” for Spaceship Earth. Five percent of the astronauts are Americans, and we are using about 20% of all the energy available on the spacecraft. As more and more astronauts crowd onboard the planet, there are only two possible alternatives. Either

Americans keep using the same energy while others have to use less and less, or we must use increasingly less while the others split more and more of our previous share among themselves.

Big Problem #2: Economic Growth. The world as a whole cannot stop using an increasing amount of the available energy. To do so would mean the entire spaceship's economy – which is hard-wired to continued fossil fuel consumption – would stop growing. And the end of growth, according to current economic theory, simply cannot be allowed to happen.

Now, there's nothing in Nature that says growth can't stop. In Nature, all growth stops sooner or later because there is no such thing as sustainable growth. Unfortunately, Nature did not design the world monetary system. Bankers did.

Recall that the world's money supply is loaned into existence as interest-bearing debt. Of course, only the amount of the principle is loaned. This means that the interest to be repaid must eventually originate from yet another loan made later in time. The inevitable result of this unsustainable Ponzi scheme – for it really is just that – is that ever more wealth – surplus wealth, in fact – must be produced in the future to repay the outstanding loans with interest. Here is the dysfunctional logic of Spaceship Earth:

- Mission Control allowed Spaceship Earth to create all its money as debt.
- Repayment of debt requires future surplus wealth creation.
- Future surplus wealth creation requires increasing resource consumption.
- Increasing resource consumption – absent undreamt-of energy efficiencies – requires increased energy supply.
- And our conventional energy supply is not only finite, but its growth is practically flat.

When energy supply (or consumption) flat-lines, so does growth. (And vice versa.) When growth stops, debt eventually goes unpaid. And that's when the fractional reserve banking system, which has much more outstanding debt than cash reserves, starts to unravel. When creditors fear they will not get repaid in the future, they call their loans due; when depositors begin to suspect their banks are insolvent, they will rush to withdraw their money. And that is when our debt-based monetary system begins to crash.

Note: Alternative and renewable energy sources will not allow us to maintain current energy consumption simply because they are too expensive – not only in dollar amounts but in the amount of energy return on investment. In effect, we have run up our debt tab when money was easy to get and will now have to pay it back with money, and energy, much harder to earn.

The Paradox: Money vs. Thermodynamics

And so we have reached what looks very much like a paradox.

Here we are hurtling through the solar system on Spaceship Earth, population 7+ billion. The number of the world's astronauts is set to increase by half again its present number, reaching perhaps 10 billion, by 2050. Human food is based on agriculture, and 100 % of American agriculture is based on fossil fuels, mostly conventional petroleum, which cannot possibly remain economical for much longer than a generation. Suicidally, it would seem, our Mission Control has allowed fractional-reserve banker subcontractors to invent a monetary system that demands infinite growth, and then mandated its installation on a spaceship Nature designed basically as a closed energy system.

The paradox lies in the incompatibility of perpetual economic growth with a spherical planet that has only finite sources of matter and energy (except for sunlight) that can be used to create future wealth. This is a very difficult concept for Americans, the wealthiest of all peoples, to grasp. But we must accept the fact that America is not immune from the laws of nature, or from the iron clad, though erroneous, logic of its debt-based monetary system.

The First Law of Thermodynamics tells us that matter and energy can be neither created nor destroyed. Money, which we use to represent exchanges of matter and energy, is the only thing in the universe that obeys no such rule. Lending money at interest both guarantees and requires the infinite expansion of the money supply, but it does nothing to increase the supply of matter and energy for which money is exchanged. If new material wealth is *not* produced as a result, economic growth stops, debts go unpaid and the cycle of money creation contracts, crashing the system in recession. If new wealth *is* produced, however, old debts are repaid by the creation of new debt, and economic growth continues – but it cannot do so forever because the growth of anything on our planet requires energy – which is limited in supply.

Geologist M. King Hubbert was a man who knew a thing or two about energy. He was the man who predicted, in 1956, that the United States' production of conventional petroleum would peak in 1970, thereafter proceeding to decline to zero – which is exactly what has happened. This is how Hubbert explained the paradox during a Congressional hearing:

“But, for various reasons, it is impossible for the matter-energy system to sustain exponential growth...and this phase is by now almost over. The monetary system has no such constraints, and, according to one of its most fundamental rules, it must continue to grow by compound interest. This disparity between a monetary system which continues to grow exponentially and a physical system which is unable to do so leads to an increase with time in the ratio of money to the output of the physical system. This manifests itself as price inflation. A monetary alternative corresponding to a zero physical growth rate would be a zero interest rate. The result in either case would be large-scale financial instability.”

Like astronaut Lovell in Apollo 13, Hubbert here is certainly understating potential catastrophe. At the very least, he was being charitable in his use of the term “large-scale financial instability.” *Collapse* would likely be a more accurate way to describe what would happen to current society if a debt-based financial system attempted to adopt a “zero interest rate” on investments.

Debt-based money is physically incompatible with the finite matter-energy system and the thermodynamic laws that govern the universe-as-we-know-it. So here we all are, stuck with a man-made monetary system that demands infinite exponential growth, which is the one thing we know for certain Spaceship Earth's energy resources can never provide. Like Apollo 13's flight controllers and designers, we not only have designed a faulty system, but we have failed to recognize it is a faulty system – even after it begins to fail.

The Apollo 13 disaster, which occurred in 1970, the year of America's peak conventional oil production, is not yet over.