Why we get bad diagnoses for the world’s energy-economy problems

The world economy seems to be seriously ill. The problem is not overly high oil prices, but that does not rule out energy as being a major underlying problem.

Two of the symptoms of the economy’s malaise are slow wage growth and increasing wage disparity. Tariffs are being used as solutions to these issues. Radical leaders are increasingly being elected. The Bank for International Settlements and the International Monetary Fund have raised concerns about the world’s aggregate debt levels. The IMF has even suggested that a second Great Depression might be ahead if major banks should fail in the manner that Lehman Brothers did in 2008.

![Figure 1. Ratio of Core Debt Growth (non-financial debt including governmental debt) to GDP, based on data of the Bank of International Settlements.](image)

If the economy were a human being, we would send it to a physician for a diagnosis regarding what is wrong. What really is needed is a physician who has a wide overview, and thus can understand the many symptoms. Hopefully, the physician can also provide a reasonable prognosis of what lies ahead.

Individual specialists studying the world’s economic and energy problems tend to look at these problems from narrow points of view. Some examples include:

- Curve fitting and cycle analysis using economic data by country since World War II, as is often performed by economists
- Analysis of oil supply based on technically recoverable reserves or resources
Analysis of fresh water supply problems
- Analysis of population problems, including rising population relative to arable land, and rising retiree population relative to working population
- Analysis of ocean problems, including rising acidity and depleting fish stocks
- Analysis of the expected impact of CO2 production from fossil fuels on climate
- Analysis of rising debt levels

In fact, we are facing a combined problem, but most analysts/economists are looking at only their own piece of the problem. They assume that the other aspects have little or no influence on their particular result. What we really need is an analysis of the overall economic malady from a broader perspective.

In some ways, the situation is analogous to having no physician with a sufficient overview of where the world economy is headed. Instead, we have a number of specialists (perhaps analogous to a psychiatrist, a urologist, a podiatrist, and a dermatologist), none of whom really understands the underlying problem the patient is facing.

One point of confusion regarding whether today’s oil prices should be of concern is the fact that the maximum affordable oil price seems to decline over time. This happens because workers around the world increasingly cannot afford to buy the goods and services that the world economy produces. Inadequate wage growth within countries, growing globalization and rising interest rates all contribute to this growing affordability problem. To make matters confusing, this growing affordability problem corresponds to “falling demand” in the way economists frame the issues we are facing.

If we believe the technical analysis shown in Figure 2, the maximum affordable West Texas Intermediate oil price has declined from $147 per barrel in July 2008 to $76 per barrel recently. The current price is about $62 per barrel. The chart suggests that downward price resistance might be reached at $55 per barrel, assuming no major event occurs to change the current trend line. Any upward price bounce would appear to leave the price still much lower than oil producers need in order to reinvest sufficiently to allow future oil production to be maintained at current levels.

Thus, our concern about adequate future oil supplies should perhaps be focused on keeping oil prices high enough. It takes a growing debt bubble to keep oil demand high; perhaps our concern should be...
keeping this debt bubble high enough to allow extraction of commodities of all kinds, including oil. Figure 1 seems to show a recent downward trend in Debt to GDP ratios for the Eurozone, the United States and China. This may be part of today’s low price problem for commodities of all types.

Needless to say, climate analyses do not consider the severity of our energy problems, nor do they consider the extent to which there is a connection between energy supply and the ability of the economy to operate as usual. If the real issue is a near-term financial crash that will radically affect future fossil fuel consumption, the climate analysis will certainly miss this event.

The Real Nature of the Limits to Growth Problem

To truly understand the headwinds that the economy is facing, we should be looking at the combined effect of all of the limits that the individual specialists have been studying. We might also include other issues not listed. The 1972 book *The Limits to Growth* presents an early computer model of how at least some of the limits of a finite world might be expected to play out.

This early approach reflected an engineering view of the problem, considering expected diminishing returns with respect to resources of all types. Other considerations included likely resource needs based on prior economic and population growth trends and efficiency gains. The Base Scenario shown in the 1972 book (Figure 3) showed collapse taking place about now—in other words, in the early part of the 21st century.
In the time since the 1972 Limits to Growth analysis was prepared, there has been a major discovery relating the importance of energy to the economy. Ilya Prigogine tackled the problem of the physics of thermodynamically dynamic open systems, earning a Nobel Prize for his efforts in 1977. **When energy flows are available, many structures, called dissipative structures, can grow and change over time.** Examples include plants and animals, hurricanes, stars (they expand in size, then collapse at the end of their lives), ecosystems, and economies. These structures are utterly dependent on energy flows. The economy needs energy in almost the same way that humans need food. Without sufficient energy flows, the world economy will collapse.

It is because of the laws of physics and energy flows that markets are able to set price levels. Indirectly, physics sets the maximum affordable price for energy products based upon the total quantity of goods and services individual workers can afford. These maximum affordable prices may be invisible, but they are very real. Economists may talk about “demand” for energy products, but the real issue is affordability: “Will the laws of physics allow prices to stay high enough to provide the commodities the world economy needs?”

It is because of the laws of physics that debt can play a major role in the economy. Debt can provide time-shifting services if an economy does not have sufficient energy supplies to permit the equivalent of bartering of finished goods and services for new capital goods. Debt can allow future goods and services (manufactured with energy products) to serve as payment for capital goods and other goods purchased using debt. Thus, debt acts as a promise of future energy supplies. These future energy supplies may not, in fact, actually be available at prices that consumers can afford. This is why debt bubbles so often collapse and have a devastating impact on economies.

In theory, the new physics discoveries might also be added to the Limits to Growth model. If this were done, I would expect the downslopes in Figure 3 to be much steeper. Also, the date when the population decline starts would likely move forward, relative to other declines. The actual dates of the declines would of course be expected to change as well, because of updated knowledge regarding resources, population, and other factors.

Including the physics aspect of the economy would lead to many periods when sharp changes take place. When these sharp changes take place, there might be wars, collapsing governments, and epidemics, all causing large numbers of deaths. Debt bubbles might pop, causing deflation and widespread banking problems. These types of events are similar to those that economies have experienced in the past. There is no reason to expect that today’s world economy will have unusual lasting power.

Of course, modeling one piece of the economy at a time, as described at the beginning of this post, leaves out such troublesome implications. Economists tell us all we need to worry about is price fluctuations as the economy substitutes one product for another. If a person has blinders on, perhaps this a good description of the world we live in. Otherwise, the model leaves a lot to be desired.

**Implication of the Laws of Physics Being in Charge of How the Economy Operates**

Politicians would very much like us to believe that they are in charge. They would like us to believe that adding more technology can solve all of our problems. They would like us to believe that citizens can make a significant difference by voluntarily cutting back on their own energy consumption. They would also like us to believe that countries can cut back on their debt levels without the whole Ponzi Scheme unraveling.
Anyone who has watched bread rise in a bowl can see the implications of growth within a finite structure. It doesn’t take very long for the volume growth of bread dough to exceed the space available. Even if the bread maker pushes the dough back down again, the effect is only temporary. The bread dough quickly rises again to overfill the bowl it is in.

One possible implication of the 2008 financial (and oil price) crash is that we are very close to limits, right now. Regulators can try to fine tune how the economy operates by raising and lowering interest rates (sometimes using Quantitative Easing (QE) in the process), but they are, in some sense, playing with fire. Figure 4 shows the dramatic impact that popping the real estate debt bubble seems to have had in 2008. It also shows the impact that adding and removing QE has had.

![Figure 4. Figure showing collapsing debt bubble at the time US oil prices peaked. Figure also shows the use of Quantitative Easing (QE) to stimulate the economy, and thus bring oil prices back up again. Ending US QE seems to have had the reverse effect.](image)

By raising interest rates, regulators could easily send part, or all, of the world’s economy to a financial crash that is worse than 2008’s. Or the economy could again reach limits, by itself, with just a little economic growth. In some sense, the world economy is very close to filling the bread bowl, as it was before the 2008 crash pushed it back down.

The World Economy Is Reaching Limits in Many Areas Simultaneously

Many people believe that we are reaching limits in at most a few areas of the economy, such as “running out of oil.” The evidence suggests that because of the networked nature of the economy, we are really reaching limits in many places, simultaneously. The following represent some problem areas:

1) **Too Low a Return on Labor for Workers Whose Jobs Are Easily Exportable.** With globalization, workers are indirectly competing with workers around the world regarding who can produce goods and services most cheaply. They are also competing with computers and robots that can easily replicate their functions. The net impact is a world where a large share of the citizens find themselves living at a level not much above the subsistence level. In more developed countries, young people may live with their parents longer and may delay
having children almost indefinitely, because wages are not keeping up with living costs. Many studies have shown rising wage disparity. In some ways, the wage disparity now seems to be as bad as in the 1930s.

Figure 5. U. S. Income Shares of Top 1% and Top 0.1% Households – Incl. Capital Gains (1913-2013)

(2) Interest Rates. Interest rates are the lever that economists like to adjust upward or downward to try to stimulate the economy or push the economy downward. Short term interest rates, up until about the end of 2015, were at the level they were at during the Depression of the 1930s.

Figure 6. Monthly average 3-month term treasury bill rates in chart prepared by FRED. Amounts shown through October 2018. Grey bars indicate recessions.

Raising interest rates is like adding a little more dough to the already over-full bread bowl. With these higher interest rates, borrowers need to pay more for monthly payments, making the strain on their finances even worse than it was previously. Figure 6 shows that raising interest rates very often creates a recession. In fact, the Great Recession of 2008-2009 seems to be the result of an increase in short term interest rates. This time we are being told that the increase will be gentle, but if the bread bowl is already overly full (in the sense that
affordability of the output of the economy is already way too low, for many workers), what difference does “gentle” make?

(3) **Return on Capital Investment/Added Debt.** Falling long-term interest rates between 1981 and 2016 seem to be an indirect reflection of falling long-term return on capital investment. If capital returns had been higher, there would be more demand for debt, forcing interest rates up to levels closer to where they had been when the economy was growing more quickly.

![Figure 7. Monthly average 10-year US Treasury interest rates in chart prepared by FRED. Amounts shown through October 2018. Grey bars indicate recessions.](image)

Another way we can look at how productive the addition of debt has been is by comparing the debt increase each year with the GDP increase (including inflation) each year. We use current year GDP as the denominator in both calculations. Figure 8 shows the indications for what the Bank for International Settlements calls “Core Debt” (that is, Total Non-Financial Debt, Including Government Debt).

![Figure 8. Dollar Increase in US Core Debt as % of GDP; GDP $ Increase as % of GDP](image)

Comparing the red and blue lines on Figure 8, GDP rose fairly reliably in the pre-1981 period, as the amount of core debt rose. The core debt increases tended to be higher than the GDP increases, but not a great deal higher.
Thus, the US ratios on Figure 1 could be close to 1.0 in early years.

Once interest rates started falling after 1981 (see Figures 6 and 7), core debt growth and GDP growth greatly diverged. I expect that quite a bit of this change was related to asset price inflation as interest rates fell. With lower interest rates, assets of all types started becoming more affordable. Thus, a greater number of buyers could be expected, driving up prices of assets of all kinds, including homes, stores, and factories. Owners of these assets could “take the equity out” as prices rose and could use the equity to purchase other goods and services. In theory, these activities might somewhat stimulate the economy. Figure 8 suggests that the benefits of these activities with respect to the “goods and services” portion of the economy (red line) were slight at best, however.

![Graph showing Financial Debt and GDP growth](image)

Figure 9 shows Financial Debt amounts corresponding to the Core Debt amounts shown in Figure 8. At first glance, it appears that Financial Debt (blue line) has provided no benefit whatsoever for the Goods and Services part of the economy (red line). But clearly the bankers who created these financial products benefitted from the income they received from them. So did the low-income home buyers who bought homes that they could not really afford in the early 2000s. Home building was stimulated, and inflation in home prices was stimulated. Banks benefitted by being able to transfer their problem home loans to unsuspecting buyers. Whether this whole arrangement had any net benefit to the economy, other than to create pseudo-solutions for people who could not really afford the homes they were purchasing, is doubtful. But when the economy is near limits, strange solutions to stimulating the economy are attempted.

(4) Commodity Prices. If we have a supply problem with one kind of commodity, we likely have a supply problem with many kinds of commodities at the same time. The reason why this happens is because the prices of many types of commodities tend to move together, in response to general market conditions. This is why the US government talks about inflation in oil and food prices as a separate category of Consumer Price Inflation.

If prices for commodities are generally low, as they have been since 2014, this means that commodity investors
have received low rates of return for several years. With low rates of return, producers of many commodities have cut back on reinvestment. With inadequate reinvestment, supply crunches are likely to occur across a broad spectrum of commodities simultaneously. A recent Wall Street Journal article says, [Supply Crunch Looms in Commodities Markets](https://www.wsj.com/articles/supply-crunch-loomss-in-commodities-markets-11502577686). The article mentions copper, zinc, aluminum and nickel. Other articles talk about oil in a similar fashion.

The question becomes, “Can consumers bid up the prices of all of these minerals sufficiently, to encourage enough reinvestment to solve the world’s commodity supply problem?” Food prices would likely need to be bid up as well, because oil is used heavily in the production and transport of food.

It was possible to bid up commodity prices in the 1970s, because the economies of the United States, Europe, Japan, and the Soviet Union were all growing rapidly. Also, women were joining the labor force in large numbers. It was possible to bid up commodity prices in the 2002 to 2008 era, because China and other Asian nations were rapidly ramping up their demand for goods and services of all kinds.

Now we are facing a much different situation. China is in much worse shape than most people recognize because its coal supply seems to have passed peak production. This has happened because the cheap-to-extract coal is mostly depleted, making it unprofitable to increase coal production without significantly higher prices. Imported coal and natural gas are expensive options. China also has a serious debt problem.

Because of China’s problems, the country will necessarily need to cut back on manufacturing, road building and home building in the years ahead. (This would happen, with or without Trump’s tariffs!) For some minerals, China currently represents over 50% of the world’s demand. China is the largest oil importer in the world. It is doubtful that China can make major cutbacks in its use of commodities without lowering prices for many commodities worldwide.
Persistence of Outdated Models

We are dealing with a situation where a large number of people suspect, at least vaguely, that the world economy is like bread dough about to outgrow its bowl, but this is not an issue anyone really wants to quantify. Everyone wants solutions; they don’t want a better delineation of the problem. Repeated publication of climate change forecasts is, in a sense, a denial of the possibility that we may be facing resource limits that are close at hand. Such publication is saying, in effect, that the closest limit that citizens need to worry about is the climate limit.

Also, the reliance of researchers on the past work by others in the same field tends to reinforce what are essentially incorrect models. Cross-pollination across fields is difficult, given the technical nature of today’s academic research. Furthermore, it becomes increasingly difficult to properly model a situation that is very complex and depends upon non-linear interactions.

Putting All of These Issues Together

The focuses of today’s narrow research can give a surprisingly distorted overview of where the economy is. A few areas in particular stand out:

(a) The choice of the word “Demand” instead of “Affordable Quantity” makes it sound like the buyer has more control over purchases than he really does. Growing demand seems to depend on continually increasing debt. This is the reason for the debt bubble problem.

(b) Framing the energy problem as “running out of oil” makes it sound like searching for substitutes will be a fruitful area for solution. Because of the affordability issue, this search is futile unless the substitutes are truly cheaper, when all costs are considered. Declining availability of many minerals because of persistently low commodity prices could be an issue as well.

(c) If limits are being reached in many areas simultaneously, incentives for countries to co-operate seem likely to go downhill quickly. Bullies who claim to be able to obtain a bigger share of the shrinking total supply will tend to be elected.

(d) The physics tie between energy and the economy makes major energy consumption cutbacks virtually impossible, without risking economic collapse.

(e) Adding technology isn’t really a solution to the debt problem, because it tends to make the affordability problem worse. The problem is that while adding technology seems to lead to more employment for a few elite workers, it tends to displace lower-wage workers at the same time. The spending of lower-wage workers is really needed if adequate demand for commodities is to be maintained. Additionally, the ownership of the technology-related capital goods tends to be concentrated among the elite; this further shifts wealth from the non-elite to the elite.

The long term prognosis for the world economy seems pretty grim, when all of these issues are put together. Defaulting debt and a resulting collapse in asset prices of all kinds is of particular concern. The default of
subprime housing debt was an issue in the US at the time of the Great Recession; the next round of defaults is likely to start elsewhere. Debt defaults could start fairly soon, perhaps in the next 6 to 12 months. The more hostile political situation we have been seeing recently seems to be evidence that limits are close at hand.