

## Our Finite World

Exploring how oil limits affect the economy

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### Oil Limits and the Economy: One Story, Not Two

Posted on [March 21, 2014](#)

The two big stories of our day are

**(1) Our economic problems:** The inability of economies to grow as rapidly as they would like, add as many jobs as they would like, and raise the standards of living of citizens as much as they would like. Associated with this slow economic growth is a continued need for ultra-low interest rates to keep economies of the developed world from slipping back into recession.

**(2) Our oil related-problems:** One part of the story relates to too little, so-called “peak oil,” and the need for substitutes for oil. Another part of the story relates to too much carbon released by burning fossil fuels, including oil, leading to climate change.

While the press treats these issues as separate stories, they are in fact very closely connected, related to the fact that we are reaching limits in many different directions simultaneously. The economy is the coordinating system that ties together all available resources, as well as the users of these resources. It does this almost magically, by figuring out what prices are needed to keep the system in balance—how much materials of which types are needed, given what consumers can afford to pay.

The catch is that the economic system is not infinitely flexible. It needs to grow, to have enough funds to (sort of) pay back debt with interest and to make good on all the promises that have been made, such as Social Security.

Energy use is very closely tied to economic growth. When energy consumption becomes slow-growing (or high-priced—which is closely tied to slow-growing), it pulls back on economic growth. Job growth becomes more difficult, and governments find it difficult to get enough funding through tax revenue. This is the situation we have been experiencing for the last several years.

We might think that governments would be aware of these issues and would alert their populations to them. But governments either don't understand these issues, or only partially understand them and are frightened by the prospect of what is happening. The purpose of my writing is to try to explain what is happening in terms that people who are used to reading the *Wall Street Journal* or *Financial Times* can understand.

I am not an economist, so I can't speak to the question of what economists are saying. I do know that what economists say tends to change from time to time and from researcher to researcher. For example, in 2004, the International Energy Agency prepared an analysis with the collaboration of the OECD Economics Department and with the assistance of the International Monetary Fund Research Department ([Full Report, Summary only](#)). That report said, “. . . a sustained \$10 per barrel increase in oil prices from \$25 to \$35 would result in the OECD as a whole losing 0.4% of GDP in the first and second year of higher prices. Inflation would rise by half a

percentage point and unemployment would also increase.” This finding is consistent with the issues I am concerned about, but I expect that not all economists would agree with it. Oil prices are now around \$100 per barrel, not \$35 per barrel.

## The Tie of Oil and Other Forms of Energy to the Economy

Oil and other forms of energy are used to power the economy. Historically, rises and falls in the use of oil and other types of energy have tended to parallel GDP growth (Figure 1).

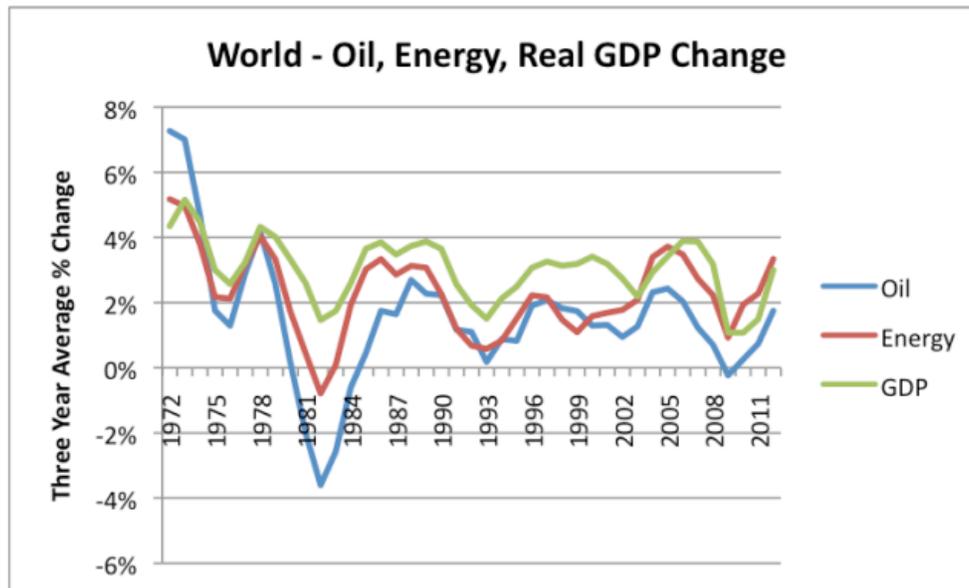


Figure 1. Growth in world GDP, compared to growth in world of oil consumption and energy consumption, based on 3 year averages. Data from BP 2013 Statistical Review of World Energy and [USDA compilation of World Real GDP](#)

There is disagreement as to which is cause and which is effect—does GDP growth lead to more oil and energy demand, or does the availability of cheap oil and other types of energy power the economy? In my view, the causality goes both ways. Oil and other types of energy are needed for economic growth. But if people cannot afford oil or other types of energy products, typically because they don't have jobs, then energy use will drop. And if oil prices drop too low, we will be in real trouble because oil production will stop.

## How Oil Limits Work

People tend to think of limits as working in the same manner as having a box with a dozen eggs. Once the last egg is gone, we are out of luck. Or a creek dries up from lack of rainfall. The water is no longer available, so we have lost our water source.

With the benefit of the economy, though, limits are more complicated than this. If we live in today's economy, we can purchase another box of eggs if we run short of eggs, assuming markets provide eggs at a price we can afford. If the creek runs dry, we can figure out a different approach to getting water, such as buying bottled water or hiring a tanker to get water from a source at a distance and bringing it to where it is needed.

Oil limits are a kind of limit we often hear concerns about. Being able to drill oil wells at all and refine the oil into products of many kinds requires a complex economy, one that can educate engineers working in oil

extraction and can build paved roads, pipelines, and refineries. The economy needs to be able to produce high tech equipment using raw materials from around the world. Thus, there must be an operating financial system that allows buyers at one end of the globe to purchase materials from the other end of the globe, and sellers to have the confidence that they will be paid for contracted products.

If a company wants to extract oil, it can almost always figure out places where this theoretically can be done. If a company can gather together all of the things it needs—trained workers; enough high tech extraction equipment of the right type; enough pollution-fighting equipment, to prevent oil spills and spills of radioactive water; and leases on land where drilling is to be done, then, in theory, oil can be extracted.

In fact, the big issue is whether the extraction can be done in a sufficiently cost-effective manner that the whole economic system can be supported. Even if the cost of extraction “looks” fairly cheap, such as in Iraq, or in some of the older installations elsewhere in the Middle East, the vast majority of the revenue that is generated from oil extraction (often as much as 90%) goes to support the government of the country where the oil is extracted ([Rogers, 2014](#)). This revenue is needed for many purposes: desalination plants to provide water for the people; food subsidies, especially when oil prices are high because food prices will tend to be high as well; new ports and other infrastructure; and revenue to provide jobs and programs to pacify the people so that the government will not be overtaken by revolt.

A major issue at this point is the fact that most of the easy-to-extract oil is already under development, so companies that want to develop new projects need to move on to locations that are more difficult and expensive to extract ([Bloomberg, 2007](#)). According to oil industry consultant Steven Kopits, the cost of one major category of oil production expenses increased by an average of 10.9% per year between 1999 and 2013. In the period between 1985 and 1999, these same expenses increased by 0.9% per year ([Kopits, 2014](#)) ([Tverberg, 2014](#)).

When production costs are higher, someone loses out. It is as if the economy is becoming less and less efficient. It takes more people, more energy products, and more equipment to produce the same amount of oil. This leaves fewer people and less energy products to produce the goods and services that people really want, putting a squeeze on the economy. The economy tends to grow less quickly because part of the goods and services available are being channeled into less productive operations.

The situation of the economy becoming less and less efficient at producing oil is called *diminishing returns*. A similar problem exists with fresh water in many parts of the world. We can extract more fresh water, but it takes deeper wells. Or we have to ship in water from a distance, using a pipeline or trucks. Or we need to use desalination. Water is still available but at a higher per-gallon price.

### **Diminishing Returns is Like a Treadmill that Runs Faster and Faster**

There are many ways we can reach diminishing returns. One easy-to-illustrate example relates to mining metals. We usually extract the cheapest-to-extract ores first. An important cost consideration is how much waste material is mixed in with the metal we really want—this determines the ore “grade.” As we are gradually forced to move from high-grade ores to lower-grade ores, the amount of waste material grows slowly at first, then dramatically increases (Figure 2).

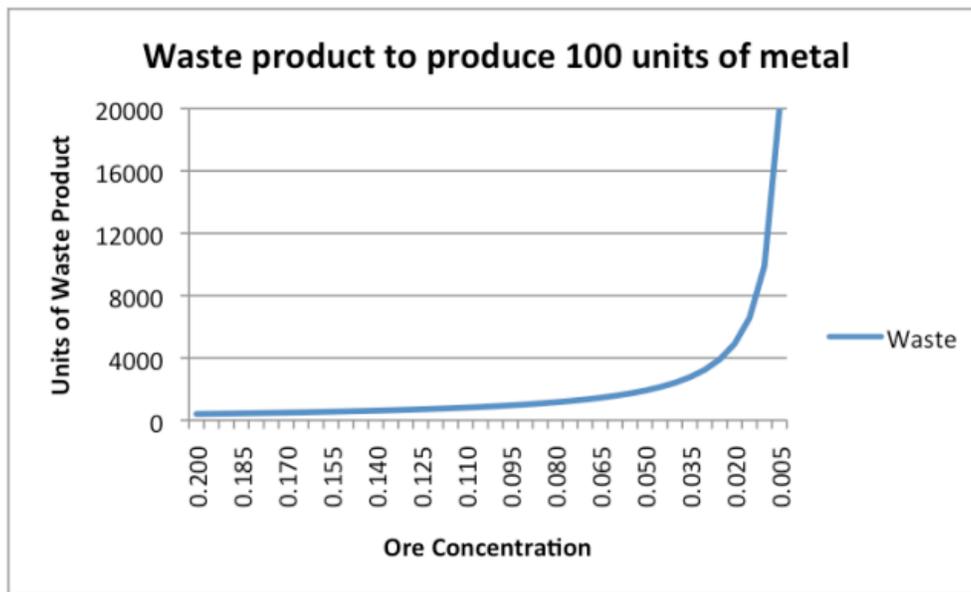


Figure 2. Waste product to produce 100 units of metal

We know that this kind of effect is happening right now. For example, the [SRSrocco Report indicates](#) that between 2005 and 2012, diesel consumption per ounce of refined gold has doubled from 12.7 gallons per ounce to 25.8 gallons per ounce, based on the indications of the top five companies. Such a pattern suggests that if we want to extract more gold, the price of gold will need to rise.

The economy is affected by all of the types of diminishing returns that are taking place (oil, fresh water, several kinds of metals, and others). Even attempting to substitute “renewables” for nuclear and fossil fuels electricity production acts as a type of diminishing returns, if such substitution raises the cost of electricity production, as it seems to in Germany and Spain.

If the total extent of diminishing returns is not very great, increased efficiency and substitution can act as workarounds. But if the combined effect becomes too great, diminishing returns acts as a drag on the economy.

### **Oil Increases are Already Higher than the Economy Can Comfortably Absorb**

For oil, we can estimate the historical impact of increased efficiency and substitution by looking at the historical relationship between growth in GDP and growth in oil consumption. Based on the worldwide data underlying Figure 1, this has averaged 2.0% to 2.4% per year since 1970, depending on the period studied. Occasional years have exceeded 3%.

The problem in recent years is that increases in the cost of oil production have been much higher than 2% to 3%. As mentioned previously, a major portion of oil extraction costs seem to be increasing at 10.9% per year. To make this comparable to inflation adjusted GDP increases, the 10.9% increase needs to be adjusted (1) to take out the portion related to “overall inflation” and (2) to adjust for likely lower inflation on the portion of oil production costs not included in Kopits’ calculation. Even if this is done, total oil extraction costs are probably still increasing by about 5% or 6% per year—higher than we have historically been able to make up.

According to Kopits, we are already reaching a point where oil limits are constraining OECD GDP growth by 1%

to 2% per year ([Kopits, 2014](#)) ([Tverberg, 2014](#)). Efficiency gains aren't happening fast enough to allow GDP to grow at the desired rate.

A major concern is that the treadmill of rising costs will speed up further in the future. If it is hard to keep up now, it will be even harder in the future. Also, the economy "adds together" the adverse effects of diminishing returns from many different sources—higher electricity cost of production, higher metal cost of production, and the higher cost of oil production. The economy has to increasingly struggle because wages don't rise to handle all of these increased costs.

As one might guess, when economies hit diminishing returns on resources that are important to the economy, the results aren't very good. According to Joseph Tainter ([1990](#)), many of these economies have collapsed.

### Why Haven't Governments Told Us About these Difficulties?

The story outlined above is not an easy story to understand. It is possible that governments don't fully understand today's problems. It is easy to focus on one part of the story such as, "Shale oil extraction is rising in response to higher oil prices," and miss the important rest of the story—the economy cannot really withstand high oil (and water and electricity and metals) prices. The economy tends to contract in response to a need to use so many resources in increasingly unproductive ways. We associate this contraction with *recession*.

We have many researchers looking at these issues. Unfortunately, most of these researchers are focused on one small portion of the story. Without understanding the full picture, it is easy to draw invalid conclusions. For example, it is easy to get the idea that we have more time for substitution than we really have. Financial systems are fragile. The world financial system almost failed in 2008, after oil prices spiked. We are still in very worrisome territory, with many countries continuing a policy of Quantitative Easing and ultra low interest rates. We may have only a few months or a year or two left for substitution, not 40 or 50 years, as some seem to assume.

Of course, if governments *do* understand the worrisome nature of our current situation, they may not want to say anything. It could make the situation worse, if citizens start a "run on the banks."

The other side of the issue is that if governments and citizens don't understand the full story, they may inadvertently do things that will make the situation worse. They certainly won't be looking long and hard at what collapse might look like in the current context and what can be done to mitigate its impacts.

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### About Gail Tverberg

My name is Gail Tverberg. I am an actuary interested in finite world issues - oil depletion, natural gas depletion, water shortages, and climate change. Oil limits look very different from what most expect, with high prices leading to recession, and low prices leading to inadequate supply.

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**Paul says:**

March 21, 2014 at 11:00 am

Another potentially massive story....

Petrodollar Alert: Putin Prepares To Announce “Holy Grail” Gas Deal With China

<http://www.zerohedge.com/news/2014-03-21/petrodollar-alert-isolated-west-putin-prepares-announce-holy-grail-gas-deal-china>

Hmmm... I wonder what the big picture is here — is the Ukraine about Russia instigating a move to dump the USD trade in oil???? And China following along...

Now that would get the attention of the US for sure — that would strike at the heart of empire. It has been said that is why Saddam had to go — and Gadaffi...

A little different situation if Russia and China pull the plug....

[Reply](#)

**Don Stewart says:**

March 21, 2014 at 11:34 am

Dear Paul

It simply doesn't make sense that the US Government is prepared to start a nuclear war to prevent the people of Crimea from seceding from a country which wants to prevent them from speaking their native language, and joining a country where they are welcome to speak their native language.

I can't believe our leaders are that stupid. So let's look for another explanation. Russia is the largest exporter of oil and gas in the world. The US would very much like to control that oil and gas. The US government operates the most pervasive 'surveillance' system the world has ever seen. And the CIA has competent analysts, as we can see by simply studying Tom Whipple's writings. So it is a reasonable assumption that the US government understands that all the stuff about 'energy independence' and 'a hundred years of gas' are just stories designed to lure the populace into a sort of daydream. The US government also knows how easy it is to get Americans worked up about Russians. So the US spends lots of money stirring up a nationalist movement in Ukraine, knowing full well that a nationalist movement will attack the ethnic Russians in Ukraine, provoking a response from Russia. Then the US and Europe try to leverage their assets to get control of the oil and gas, one way or the other. The goal is simply to get the multinational oil companies ownership of the oil and gas assets in Russia, to stop the decline in their production.

Don Stewart