Losing Faith in Economics
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Energy Price Increases and the 2008 Financial Crash: A Practice Run for What’s to Come?

By Charles A. S. Hall and Andy Groat

“Thus the question becomes: can we supplement or improve upon our ability to do economics and financial analysis by using procedures that focus more on the energy available (or not) to undertake the activity in question?”

The summer of 2008 saw the third year in a row in which oil production did not rise, leading some to say that the long predicted “peak oil,” the time of maximum global oil production, had indeed arrived. Partly as a result, that summer also saw the highest oil prices ever, as well as historically high prices for other energy and most raw materials. Wall Street was down from its historic high of the preceding fall but by the end of the first week of August, the Dow Jones Industrial average closed at 11,734. Then, a series of disasters struck the financial markets, with many of the largest, most prestigious and seemingly impervious companies declaring bankruptcy. Each week the stock market lost 5 or 10 % of its value until, by the end of November, the Dow Jones had dropped to as low as 8,000. Many investors lost from one-third to one-half of the value of their stocks.

Although the media and American lawmakers focused on many issues as the culprits of the crash — the sub-prime mortgage crisis, high foreclosure rates and Wall Street’s sale of opaque financial products known as derivatives — we believe that the root cause of the current downturn is the same one that sparked the last four out of five world recessions: the high price of oil. Why did most economists and financial analysts not see this coming? One hypothesis, advanced by Nobel laureate in economics Paul Krugman (2009) is that the economics profession “went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth.” But, as the market debacle has shown, mathematical elegance in economics is not a substitute for scientific rigor, something that we have discussed in many previous papers (e.g. Hall et al. 1986, Hall et al. 2001).

As of this writing global oil production had been flat since 2004 and then declining for several years so that peak oil appears to have occurred – with the remaining debate only about whether there may be a subsequent peak. If indeed we have passed the global oil peak – or at least have reached the point at which an increase in annual production is no longer possible – then indeed the end of cheap oil might be soon upon us, especially if global economies return to growth. Because of the critical importance of liquid and gaseous petroleum for essentially everything we do economically, there are major concerns as to what the financial implications might be. Some (ourselves included) ask whether conventional economics and
conventional economic models and tools work only when it was possible to readily expand the petroleum supply. Will our conventional economic approaches, derived during periods of expanding energy supplies, have less relevance during times of contracting supplies? In other words, are finances beholden to the laws of physics? We think yes. Thus the question becomes: can we supplement or improve upon our ability to do economics and financial analysis by using procedures that focus more on the energy available (or not) to undertake the activity in question?

THE PREDICTORS

What is the relation, if any, between the run up in oil prices and the market crash? Resource scientists have predicted such a financial crash for a long time. Any good physical or biological scientist knows that all activity in nature is associated with energy use. Consequently, many in the scientific community were not the slightest bit surprised by the financial crash or its timing. For example, Colin Campbell, a former oil geologist and co-founder of ASPO, the Association for the Study of Peak Oil, predicted serious financial responses to peak oil in his (and Jean Laherre’s) classic Scientific American article “The End of Cheap Oil” (Campbell and Laherre 1998). He was more explicit in the ASPO meeting in Pisa, Italy, in 2006 when he said that we are likely to see an end of year after year economic growth and a movement to an “undulating plateau” in oil production, prices and economic activity, with periodic high prices in oil generating financial stress. These financial strains would, in turn, cause a decrease in oil use and hence a price decline, with low prices then leading to new financial growth and new increases in use followed, eventually, by increases again in oil prices. In other words he foresaw very large impacts of restrictions in oil availability, and consequent price increases, on the market: “Every single company on the stock market is overvalued from the perspective of what the cost of running that company will be after peak. Value is determined by performance which has been based on cheap oil.”

Many other analysts have remarked upon, and even predicted, the probable impact of peak oil, or at least oil price increases, on the financial status of the United States and the world (e.g. Huang et al. 1996; Sauter and Auerbach 2003). A thoughtful, chilling and ultimately correct view of the implications of peak oil on the American economy was presented by Gail Tverberg in January 2008 on the energy log site “The Oil Drum”. Her predictions, which we thought impossibly pessimistic at the time, have been vindicated in great detail. Many analysts foresaw these issues as early as the 1970s, including the authors of the famous but subsequently dismissed “Limits to Growth” studies of 1972, ecologists Garrett Hardin and Howard Odum, economists Kenneth Boulding and others. The first author of this piece made his retirement decisions in 1970 based on the assumption that peak oil and a crash of stocks would occur in about 2008 (Hall 2004). The reason is that all of these people understood that — of necessity — real growth is based on growth in real resources, and that there are limits to those resources. The case for peak oil was clearly laid out 40 years ago by Hubbert (e.g. 1968; 1974) who had correctly predicted the U.S. peak in 1970, 15 years before the fact. While many economists place a great deal of faith in increasing technology, in fact technology does not operate on a static playing field but continually competes with declining resource quality. There is little or no evidence that technology is winning this game (e.g. Hall and Ko
2004, Hall et al. 2008, Gagnon and Hall 2009), and it is important to understand that at least so far, the Limits to Growth model is an almost perfect predictor (Hall and Day 2009).

Resource-based analysts understand and appreciate that the recent turmoil in much of our financial structure has many plausible causes, among them greed, the relaxation of financial controls, sub-prime mortgages, the decrease in risk premiums, excessive leverage, and overrated bundles of toxic securities. But, in the minds of resource-based analysts, energy underlies even these issues. The fundamental dilemma is this: if oil, the most important energy source to fuel the economy, goes through the inevitable path of growth, plateau, and eventual decline (i.e. peak oil) while the financial market is built on the assumption of unfettered growth, then something has to give. Eventually the aspirations and assumptions of indefinite growth in assets, production and consumption must collide with the reality of an ever-constricted source of the energy that fuels real growth. There are related, but more subtle, arguments as well.

Starting in the early 1990s until 2007, the financial system, with various forms of new financial engineering, had seen an unprecedented increase in the use of leverage. Relatively inexpensive oil, declining interest rates, and globalization all contributed to declines in risk premiums for virtually all asset classes. Capital went further out on the risk curve to make up for reduced returns and increased leverage became the new norm. As volatility seemed to disappear, even more leverage was piled on to the system. Along with the changing landscape in global credit markets came cheap financing for U.S. home buyers. The low price of energy greatly increased discretionary income which further encouraged people to take advantage of this cheap financing, all of which added to massive residential development.

This created a self-reinforcing “reflexive” system (Soros 1987), where increasing home values increased collateral, which encouraged further borrowing in the household sector and lines of credit for consumption and so on. But the U.S. reached a “tipping point” (Gladwell 2000) in 2006-2007. As the price of gasoline rose, the assumption that the suburban lifestyle would be sustainable became a question in every driver’s mind. The most audacious growth in real-estate had been in the ex-urban areas, most vulnerable to gas price spikes. The system had been built on the premise that large amounts of discretionary spending would always be available and the notion that everyone was entitled to a McMansion, a “lawyer-foyer,” and a home theater. To get it, we had to build out from the cities. However, discretionary wealth — that which is available for non-essential investments and purchases — is extremely sensitive to volatile energy prices (Hall, Powers and Schoenberg 2008).

Discretionary income dropped substantially when gasoline and other energy prices, which had been creeping up from a very low level in 1998, increased sharply in 2007-2008. This became a domino that toppled aggregate demand, particularly for ex-urban real estate. It may have been that this was the first domino that triggered the massive de-leveraging we are now experiencing globally. (A good summary of the various analyses by Rubin, Hamilton and others who argue that oil price increases were behind this, and past, recessions is given at http://netenergy.theoldrum.com/node/5304.) Massive household debt could not be supported when the value of the underlying collateral declined: a decline triggered, at least in part, by the spike in energy prices. As the collateral disappeared, huge derivative positions...
that had been built in the previous decade had margin-calls. The spiral down of forced selling pressured all asset classes further, and forced the banking sector to essentially freeze in September of 2008. Will this questioning of the suburban model be a preview to our ultimate response to peak-oil? Perhaps. The general pattern of oil price changes can help us understand these things better in the longer term.

At the start of 1973, oil was cheap at $3.50 a barrel. The U.S. was still the world’s largest producer. Peak oil had just occurred in the United States in 1970, but no one noticed. Oil imports and the economy kept growing. As domestic oil production in the U.S. declined from 1970 to 1973, foreign suppliers gained leverage. Political events and a bulldozer accident that severed an export oil pipe in the Middle East triggered massive price increases in oil. By 1979 the price of oil had increased by a factor of ten, to $35 a barrel. The proportion of Gross Domestic Product that went to buying energy increased from about 8% to 14%, restricting discretionary spending for all while causing stagflation (Figure 1). The prices of other energy and commodities more generally increased at nearly the same rate, driven in part by the price increase of the oil that was behind all economic activities.

But then, in the 1980s, all around the world oil that had been found but not developed (as it had not been worth much) suddenly became profitable to develop, and it was developed. By the 1990s the world was awash in oil and the real price fell to nearly what it was in 1973. The energy portion of GDP fell to about 5%, essentially giving everyone a sudden free extra 8 to 10% of their incomes to play with. The impact on discretionary income, perhaps a quarter of the total, was enormous. Many invested in the stock market, but the burst tech bubble of 2000 cured them of that. Real estate was considered a “safe” bet, so many invested in what was really surplus square footage. Speculation became rampant as real estate was valued for its financial returns rather than as a place to live. For a while it seemed as if investment in real estate was the best thing for everyone but, as we now recognize, most of the increase in wealth was illusory.
With energy price increases over the past 6 years (until the summer of 2008), an extra 5 to 10% “tax” from increased energy prices was added to our economy as it had been in the 1970s, and much of the surplus wealth disappeared. Speculation was no longer desirable or possible as consumers tightened their belts because of higher energy costs. While this perspective is not a sufficient explanation for all that has happened, the similar economic patterns in response to the energy price increases of both the 1970s and of the last decade give it credibility. In systems theory language, the endogenous aspects of the economy that the economists focus on (Fed rates, money supply, etc.) became beholden to the exogenous forcing functions of oil supply and pricing that are not part of economists’ usual framework.

**THE RELATION OF OIL AND ENERGY MORE GENERALLY, TO OUR ECONOMY**

While economics is overwhelmingly taught as a social science, in fact, our economy is completely dependent upon the physical supply and flow of resources, including materials and energy, for the production, transport and use of goods and services. Specifically, our economy is overwhelmingly dependent upon oil, which supplied about 40% of U.S. energy use in 2007, and natural gas, which supplied about another 25%. Coal provides about 20% and nuclear a little less than 5%. Hydropower and firewood supply no more than 4% each. Wind turbines, photovoltaics and other new solar technologies together account for less than 1%. Global percentages are similar. Our economy has been and continues to be based on increased use of fossil fuels for most of its growth, so that we have in recent years added much more new capacity with fossil fuels than we have with new solar, which has only added a bit to total growth in the use of all energies rather than replaced fossil fuels.

Although we have been trained from birth to think about the economy as something run by money, from our perspective money is just our means of keeping track of the energy flows and investments. The fossil fuel-based economy has given each of us the equivalent of 60 to 80 “energy servants” and the more money you earn, the more energy servants you have. Each time you spend a dollar, roughly a coffee cup’s worth of oil (or some other energy) has to be pulled out of the ground, refined, transported and burned to provide the energy for that economic activity. For example, if you buy a bagel for a dollar, natural gas is used to make fertilizer, diesel is used to drive a tractor to plant and harvest the wheat, electricity is used to grind the wheat and more diesel is used to ship the flour from Kansas to wherever the bagel will be made, using, of course, more energy during baking. Food eaten in the United States, on average, requires about 10 times more calories of fossil fuel for its production than is found in the food itself (Hall et al. 1986).

Because of the enormous interdependency of our economy, there is not a huge difference in the energy requirements for the various goods and services that we produce. Thus a dollar spent for most final demand goods and services uses roughly the same amount of energy no matter what the good or service is. An exception is money spent for energy itself, which includes the chemical energy plus another 10 or so percent which is the energy needed to get it. For 2005 an average dollar spent in the economy required about 8 or 9 megajoules (1 MJ equals 240 Kilocalories) for that activity. For heavy construction the estimate is about 14 MJs per dollar and for very heavy industry such as obtaining oil and gas about 20 MJs per dollar; Gagnon et al. 2009). As time and inflation proceed you have less and less energy to do work in the economy per dollar spent. There continues to be decreasing energy return on
energy invested (EROI) for our major fuels as we must go after ever more difficult resources (e.g. Hall and Cleveland 1981, Gagnon et al. 2009).

MAKING INVESTMENT DECISIONS

There is an implicit assumption, probably believed by most market analysts, that if they (collectively) make good financial decisions, based on market information, market projections and good hunches, then we collectively (i.e., society) will make the best investments possible. Although there are certainly good rationales that such financial analyses make considerable sense, in many cases it is not so clear that they are an effective guide to the future of energy supplies. This is because: 1) current prices of energy in the U.S. are greatly influenced by various subsidies; 2) few understand the degree to which most technologies today are principally a means of subsidizing whatever it is we do with still-cheap petroleum; 3) today’s price signals are unlikely to be influenced by the future conditions when today’s most abundant and cheapest fuels may be scarcer, for either geological (depletion) or political reasons; and 4) there is painfully little transfer of information from the (rather limited) scientific community that has examined the large picture of energy to the financial communities.

We include here some preliminary analyses that we think show the importance of energy to Wall Street and the economy more generally. First, Wall Street prices reflect not only a portion of the real operation of the economy but also a large psychological factor often called “confidence”. Our hypothesis is that the energy used by the economy is in some sense a proxy for the amount of real work done, and that over time the Dow Jones should “snake” around the real amount of work done, reflecting issues of speculation, confidence and so on, but that over sufficient time it must return approximately to the real energy use line. To test this hypothesis we have plotted the prices of the Dow Jones index (corrected for inflation) from 1915 until 2008 along with the actual use of energy by the United States economy. In fact the inflation-corrected Dow Jones Index has snaked around the use of energy (Figure 2). We think it will be interesting to plot this relation in the future. We hypothesize that the Dow Jones will over the long run continue to snake about the total energy use in response to periods of irrational exuberance and the converse. If U.S. total energy use continues to decrease, as it has for the last 18 months, this hypothesis implies no sustained real growth for the Dow Jones. We also hypothesize that in a general sense the amount of wealth generated by the U.S. economy should be closely related to fuel energy use. Cleveland et al. (1983) found that the Gross National Product of the United States was highly correlated with quality-corrected energy use from 1904 to 1984 ($R^2 = 0.94$). This high correlation appeared to be much poorer for the period 1984 until 2008. It is possible that the divergence is due not to increasing efficiency but rather an increasing proclivity of governments to “cook the books” on inflation (see the online group shadowstatistics.com). Correcting for this, if indeed that is needed, would make the relation of energy use and GDP growth much tighter through the 1990s and 2000s.
Jeff Rubin, Chief Economist at CIBC World Markets, wrote in a recent report that defaulting mortgages are only a symptom of the high oil prices. Higher oil prices caused Japan and the European Nations to enter into a recession even before the most recent financial problems hit. According to Rubin:

Oil shocks create global recessions by transferring billions of dollars of income from economies where consumers spend every cent they have, and then some, to economies that sport the highest savings rates in the world. While those petro-dollars may get recycled back to Wall Street by sovereign wealth fund investments, they don’t all get recycled back into world demand. The leakage, as income is transferred to countries with savings rates as high as 50%, is what makes this income transfer far from demand neutral. [...] By any benchmark the economic cost of the recent rise in oil prices is nothing short of staggering. A lot more staggering than the impact of plunging housing prices on housing starts and construction jobs, which has been the most obvious brake on economic growth from the housing market crash. And those energy costs, unlike the massive asset writedowns associated with the housing market crash, were borne largely by Main Street, not Wall Street, in both America and throughout the world.

This big increase in oil prices has caused the annual fuel bill of OECD countries to increase by more than $700 billion a year, with $400 billion of this going to OPEC countries. Rubin asks: “Transfers a fraction of today’s size caused world recessions in the past. Why shouldn’t they today?”

We and others believe that there is ample evidence that our economy is beholden to energy supplies and prices, and that good investors and good economists need to learn a great deal more about energy. We are attempting to tackle this problem head on through the
development of a new approach to economics called biophysical economics (e.g. Hall et al. 2001, Hall and Klitgaard 2006, Hall et al. 2008, Hall and Klitgaard in preparation). It is based on the simple premise that since economics is about the production and transfer of physical things or services that require energy, why should it be considered a uniquely social, rather than equally a biophysical science? Probably most readers of this article understand in their day-to-day work that the economy doesn’t work the way economics textbooks say, if indeed it ever did. But getting the economists to re-think their training will be a tough job, no matter how much that is needed.

References

Colin Campbell: http://www.youtube.com/watch?v=IDNjV6sumQ&feature=related


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For more information or to become a member of ICCR please contact ICCR’s Member Relations Associate Allison Lander at alander@iccr.org or 212-870-2984.

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