Tipping Point: Near-Term Systemic Implications of a Peak in Global Oil Production--Principal Mechanisms Driving Collapse

Posted by Gail the Actuary on April 21, 2010 - 8:30am

Topic: Economics/Finance

Tags: david korowicz, economic collapse, economics, feedback mechanism, globalised economy, money supply, tipping point paper [list all tags]

Recently, a 55 page paper called Tipping Point: Near-Term Implications of a Peak in Global Oil Production (PDF warning) was published as the joint effort of two organizations: Feasta and The Risk/Resilience Network, with lead author David Korowicz. We have recently published three excerpts from that paper, which can be found at this link. This is a fourth excerpt.

6. Principle Feedback Mechanisms Driving Collapse

6.1 Introduction

We currently live within an integrated complex globalised economy. We have framed the process in which this occurs as a catastrophic bifurcation, driven by a series of reinforcing positive feedbacks (sec: 4.2). The final point will be a de-globalised (localised) economy of much reduced complexity.

We begin with the state of globalised civilisation that we argued in sec: 4.1 has been in a relatively stable dynamical state for the last century and a half or so. In its broadest outline we might say that declining energy flows reduce economic activity which further reduce energy flows. A series of increasingly severe processes are set in train which start to cause cascading collapse in major hub infrastructures and the operational fabric of the global economy. These processes have different time-scales, some could evolve over years, some could be relatively abrupt but because of coupling between them, the faster processes are likely to lead the overall collapse rate.

Recently, a 55 page paper called Tipping Point: Near-Term Implications of a Peak in Global Oil Production (PDF warning) was published as the joint effort of two organizations: Feasta and The Risk/Resilience Network, with lead author David Korowicz. We have recently published three excerpts from that paper, which can be found at this link. This is a fourth excerpt.

6. Principal Feedback Mechanisms Driving Collapse

6.1 Introduction

We currently live within an integrated complex globalised economy. We have framed the process in which this occurs as a catastrophic bifurcation, driven by a series of reinforcing positive feedbacks (sec: 4.2). The final point will be a de-globalised (localised) economy of much reduced complexity.

We begin with the state of globalised civilisation that we argued in sec: 4.1 has been in a relatively stable dynamical state for the last century and a half or so. In its broadest outline we might say that declining energy flows reduce economic activity which further reduce energy flows. A series of increasingly severe processes are set in train which start to cause cascading collapse in major hub infrastructures and the operational fabric of the global economy. These processes have different time-scales, some could evolve over years, some could be relatively abrupt but because of coupling between them, the faster processes are likely to lead the overall collapse rate.

6.2 Monetary System & Debt

6.2.1 Credit in the Economy

Credit in its various guises is the unifying embedded structure in the global economy. Credit underpins our monetary system, investment financing, government deficit financing, trade deficits, Letters of Credit, the bond market, corporate and personal debt. Credit and the promise of future economic growth support our stock market, production, employment and much else besides. It is the primary institutional infrastructure of the global economy.

The money flowing through our economy has been created through the issuance of debt [56] Money enters the economy when banks create money in return for the promise to repay that debt with interest at some time in the future. All positive balances in our accounts, except for a very small percentage reserve, are lent out to others at interest. Debt and money are the mirror of each other. If we all paid back the money we owed, there would be no money left in circulation, and the interest on the debt would be left unpaid.

Money supply is the balance between loans being taken out, and loans and interest being repaid. At any time, the money supply is insufficient to repay the total amount of debt outstanding with interest. In order to pay back loans in aggregate, more loans must be taken out for consumption and investment than the repayment of old loans. Thus in order for debt to be repaid, money supply must increase year-on-year. This can be done either by increasing GDP and/or inflation. Our monetary system depends on continually increasing debt outstanding and GDP for its stability.

Bank reserves represent much less than 10% of money owed to depositors by banks, which means they do not have the money to repay their debts to their depositors. This implies a strong level of collective trust: when we lose trust, bank-runs can ensue, potentially collapsing the banking system. If we lose the banking system, the society wide implications for welfare can be severe. In general, shocks of this kind can be transmitted and absorbed by governments, central banks, society at large, and international institutions. This too implies a level of trust in the adaptive capacity of globalised networks to contain the damage and prevent contagion. Local shocks can in general be contained, but because of the level of integration and tight coupling some shocks can rapidly rattle the world as the current crisis attests. At the core trust in monetary system is largely assumed throughout the globalised world. But with the loss of that trust, the system's ability to absorb the shock is lost, for the system depends upon that trust. Further, that trust depends upon continued economic growth, because only by growth can the devastation of hyper-inflation, deflation, and monetary collapse be avoided.

The economist Paul Seabright sees trust as a central underpinning of the global monetary system, and thus the trade networks upon which we rely[57]. Trust between unrelated humans outside our own tribal networks cannot be taken for granted (would you trade with a random stranger across the globe and send real money or goods without the reassurance of some guarantee of honest completion or ability to punish a defaulter?). Because trade is in general, to all our benefit, we have developed institutions of trust and deterrence ('good standing', legal systems, the IMF, banking regulations, insurance against fraud, and the World Trade Organisation etc) to reinforce cooperation and deter freeloaders. Trust builds compliance, which confers benefits, which then builds trust. But the reverse is also true, a breakdown in trust can cause defections from compliance further reducing trust.

6.2.2 Credit & Monetary Collapse

Increasing debt, and thus money supply, without a corresponding increase in GDP, leads to a devaluation of money's purchasing power which is inflation. But increasing GDP requires increasing energy and material flows. With an energy contraction, the economy must contract. In a growing economy, debt can be paid off on average, as the growing 'pie' allows the payment of the principle plus interest. In a permanently contracting economy, the shrinking pie cannot cover even the repayment of the principle. Another way of putting it is that reducing energy flows cannot maintain the economic production required to service debt. All the money in the world could not repay debt outstanding--mass default or hyper-inflation are the only ways out. Credit, the life-blood of economies must dry up.

This means that we are moving into a period of extreme monetary uncertainty, framed by the global economic crisis's intersection with energy constraints and its consequences. We would expect a continuation or initiation of deflationary trends within economies. That is, money supply decreases, and that in turn causes prices to drop relative to goods and services produced. This is firstly because increasing spare production capacity and fears of future business failures and job losses reduce demand for new loans. Lower production and margins in the economy increase the relative debt burden which puts further pressure on consumer, corporate, and government borrowing. Even though people and companies may continue to service their loans, growing bad debts may force banks to write off their capital, the basis of their ability to make new loans under the fractional reserve banking system. Perceptions of future risk will reduce consumption and increase interest rates, further stalling economic activity. This deflationary process is self-reinforcing. Under normal recessionary conditions, governments might step in to maintain demand and liquidity through deficit spending or quantitative easing. But underlying such initiatives is the assumption that growth will return facilitating the repayment of sovereign loans and acting to mop up excess liquidity.

At this moment, increasing concern is being expressed over the risks of sovereign defaults, commercial property defaults, and credit card defaults. If we assume that as time goes on, the implications of an energy withdrawal become clearer to some potential creditors, one might expect rising interest rates, loans having shorter terms, and eventually the absolute refusal to finance most loans. Why lend more to someone who will not be able to repay the loans they already have outstanding? Eventually, it will become clear that almost all debt outstanding cannot be repaid, except in hugely devalued money.

If a small percentage of people in an economy cannot service their debts, their secured assets may be taken. This is necessary to maintain the banking system's viability. Likewise, a nation's standing within the bond market is dependent upon it striving to repay its debts. But there must come a point when a critical mass of defaulters rises to such a level that there is no longer the political will to enforce the confiscation of assets, or there is active defiance against debt collectors. Furthermore, when a nation realises the bond market will no longer facilitate borrowing because growth cannot be maintained, the market and social cost of defaulting drops, while the benefit of doing so rises. This social cost, in general, falls further in the queue, the farther you fall behind the initial defaulter.

Increasing fears of banking collapse are likely to lead to panics by depositors trying to retrieve their money, but as we have seen, the money is not there. Traditionally the job of the Central Bank is to stand behind a bank with emergency cash. But such models are not designed to manage a system-wide insolvency crisis on this scale.

We can ask what this means for the monetary system. We remember that we only exchange something of intrinsic value for money, if we assume that money can be exchanged elsewhere for something of intrinsic value in time and space. The two monetary conditions for this are stable exchange rates and low inflation. Both of these embody our trust in counter-party currencies and our perceptions of future risks. The other co-dependent pillar of the monetary system is bank intermediation. But the banking system of necessity must become insolvent as their assets (loans) vaporize and their capital disappears. However, unlike today there can be no bail-out as governments will be just as insolvent. We can list some of the risks to monetary stability:

- As money supply shrinks, unemployment rockets, and government finances fall apart, there will be the temptation to assuage short-term public anger by printing money to pay wages. This could drive inflation and hyper-inflation.
- A severe collapse in production and supply chains could lead to an overhang of money in an economy as against goods and services, driving inflation.
- Fears of inflation, and fears over expectations of future availability of important goods, could drive inflation.
- A collapse of the banking system and/or a failure of banking infrastructure (see sec. 6.4)) may mean that money and records are not available to enable transactions. Since some 97% of money is digital, and the global ability to print quality notes per unit of time is small, there is a possibility of an almost complete absence of tradable money.
- If production collapses in potential trading partners, there is likely to be increased banking intermediation risk, increased risks of civil unrest, and a loss of trust; one may not want to hold that country's currency as there is a large risk of not being able to exchange it for intrinsically useful assets. For similar reasons, they may not want to hold our currency. This becomes a mutually reinforcing feedback driving out monetary confidence globally.
- Money, and exchange rates we might say, are becoming opaque. Difficult to value in space, which supports trade; and time, which supports investment and saving; which together scupper economic life.

Bank intermediation, credit, and confidence in money holding value is the foundation of the complex trade-networks upon which we rely. The financial situation described will expose what heretofore has not been a problem; the mismatch between our dependencies upon globalised integrated supply-chains, local and regional monetary systems, and nationalised economic policy. A complete collapse in world-trade is an extreme but not unlikely consequence.

The failure of production within the economy will mean that almost all income is absorbed by food and energy, but there will be little income to pay for it. Importing energy, food, and inputs for the production process into a country will only be possible by exporting something of equal value because running trade deficits is based upon credit. Monetary opaqueness may mean that barter or hard currency (gold, oil, grain, wood) may be used to settle accounts.

With the collapse of production within a country comes the collapse of exports too, from which follows a further inability to import energy or materials to increase production. As explained earlier, modern economies produce almost nothing indigenously, increasing dramatically the probability of supply-chain breakdowns causing key inputs in the production processes to disappear, further stalling production. Thus countries are likely to remain trapped with limited economic activities.

And because our supply-chains are so complex and globalised, we may not be able to import important items even if we had something to exchange. This happens because our supplier may have lost some critical inputs into its supply-chain, or lost its operational, social, or informational capacity locally. This means that local supply-chain failures quickly become globalised.

6.3 Financial System Dynamics

Money only has value because it can be exchanged for a real asset such as food, clothing, or a train journey. As long as we share the confidence in monetary stability we can save, trade and invest. Like bonds and shares, it is a *virtual asset*, as it represents only a claim on something physically useful[58]. However, the current valuation of virtual assets towers over real productive assets on which their value is supposed to be based. A bond is valuable because we expect to be paid back with interest some years hence; paying twenty times earnings for shares in a company is a measure of confidence in the future growth of that company. The output of real productive assets must collapse because of energy and resource constraints and the failing operational fabric. The implication is that virtual wealth including pension funds, insurance collateral, and debt will become worthless.

The acknowledgment by market participants that peak oil is upon us, coupled with an understanding of the consequences is likely to permanently crash the global financial system. That is, the behavior of the market is based on a combination of (a) fundamental physical constraints, such as rising loan defaults induced by the current economic crisis, (b) energy and food price inflation, and (c) interactions of (a) and (b) with the hopes and fears of market participants, particularly their faith in the overall stability and continued growth of the system. The transition from a few market participants accepting the idea that peak oil is a major constraint, and large-scale acceptance can be very rapid, though the onset of the fast transition can be difficult to predict. In other words: growing government, corporate, and public acceptance of peak oil, will initiate a fear-driven conversion of a mountain of paper virtual assets into a mole-hill of resilient real assets which will help precipitate an irretrievable collapse of the financial and economic system. Such a transition can be expected to be fear-driven and mutually reinforcing. This is part of the reflexivity of markets, in George Soros's phrase; or an example of a positive feedback, in the language of dynamical systems. In this context we can understand reported pressure placed upon the International Energy Agency by the United States to overstate future production in its World Energy Outlook 2009[59].

The end-point will be a collapse in bond and equity values. This is a result of various reinforcing processes, including loss of confidence in debt repayment, monetary confidence, supply-chain disruption, evolving diseconomies of scale, and massive potential losses in discretionary consumption.

The result for market participants would be a rush to extract virtual assets (money, bonds, shares, derivative instruments) to convert them into productive, non-discretionary assets (resilient energy assets, land, farm tools, gold). However, there is a vast imbalance in their respective size. In all, total paper assets are probably valued at over $300Tr, supported on a Gross World Product of about $55Tr, which itself must collapse. In comparison, the total clean-tech market capitalisation is about $1 Tr. In order to get an indication of the ability of the clean-tech sector to absorb investment, we note a record global investment in renewable power of $140 billion in 2008. The vast mismatch is clear, even assuming there were willing sellers of renewable assets or land. Green-field renewable infrastructure investments (building wind turbines, solar PV cells, DC cabling) are likely to have limited ramp-up rates, which if on the scale of investment increases between 2007 and 2008 would be of the order of 16%. This means pension funds, sovereign funds, insurance funds, and other major holders of such assets will lose everything, with little hope of asset conversion. Maintaining value in cash is likely to be ineffective because of deflation blocking conversion, or extreme inflation eroding the valuation of cash holding.

It should be clear from the body of the text that one could expect much of the greentech sector to collapse due to failing operational fabric, so the rush will be to secure actual turbines/solar PV panels, or to produce them before systems begin to fail.

This means that there is a very small conversion window and that only a tiny fraction of investors will get out of virtual assets, to secure the small amount of real resilient assets.

6.4 Critical Infrastructure

Economies of scale are the familiar benefits of a globalised world. They mean that not only can goods or services be produced more cheaply, meaning greater sales volumes, but also their availability frees up discretionary income that can be spent on other goods and services.

In the energy-economic environment so far discussed, this process goes into reverse. The rising prices of goods (because of the energy and resource cost, supply-chain and money risk reasons) and the reduced discretionary income reduces the number of goods sold, thus reducing broader economies of scale. These feed back into the rising cost of goods, reducing further the number of sales. This dynamic is expected to be most forceful for the most advanced technologies.

For example, as fewer users can afford to replace mobile phones or computers, or use them less, the cost of the personal hardware and maintaining the network rises per user. Rising costs mean less discretionary use. But because common IT platforms require a large number of users, and economies of scale support the most discretionary use (say Facebook, texting, and Playstation) and the more important uses (business operations, banking, electric grid emergency services), the cost for businesses and critical services is likely to begin to escalate.

The components of infrastructure have been designed with the assumption that inputs to maintain, repair and upgrade would be on-stream. In addition component lifetime is often short (3-5 years for laptops and mobile phones). Furthermore most faults cannot be repaired locally without complex ready-packaged components.

We remember that the most complex infrastructure has the most complex supply-chains and is more likely to have more inputs with fewer substitutes. Thus there is greater risk of critical infrastructure operational failure for want of a critical element. The complex sourcing and production over the globe means each nation's particular economic, monetary, and social predicament becomes tied to our own, and ours to theirs.

To the above risks we must add the local economic and monetary risks, and our ability to import energy. This interacting nest of conditions means that we could see cascading failures in the grid, health service, IT systems, telecommunications, and water/sewage systems. This leaves us with the risk of a near complete systemic failure in the operational fabric upon which our welfare depends.

Failing infrastructure feeds back into reduced economic activity and energy use, further reinforcing failing infrastructure.

6.5 Food

Global food production is already straining against a rising demand and the stresses of soil degradation, water constraints, over-fishing, and the burgeoning effects of climate change[60]. It is estimated that between seven and ten calories of fossil fuel energy go into every one calorie of food energy we consume. For example, it has been estimated that without nitrogen fertilizer, produced from natural gas, no more than 48% of today's population could be fed at the inadequate per capita level of 1900[61]. Today it is true to say that no country is self-sufficient in food production.

The fragility of global food production will be exposed by a decline in oil and other energy production. It is not just the more direct energy using inputs that would be affected such as fertilisers, pesticides, seeds, and diesel spares for machinery, and transport. The failing operational fabric may mean there is no electricity for refrigeration, for example.

It should be clear even from the above overview that a major financial collapse could not just cut actual food production, but could result in food left rotting in the fields, an inability to link surplus production with those in need, and an inability to enact monetised food transactions.

Our critical reliance upon complex just-in-time supply-chain networks mean that there is little buffering to protect us from supply shocks. In the event of a shock, and without any planning, it is likely that unrelieved hunger could spread rapidly. Even for a country that could be food independent, and even a potential net exporter, it may years to transition as old systems fail and new ones put in place (rationing systems, education, re-location of farm laborers, horse breeding, nutrient re-cycling systems, seasonal re-adjustment of production, tool production, storage and preservation skills and products). In the interim, the risks are severe.

6.6 Energy Production

We have focussed upon peak oil, although we have mentioned concern about peak gas and even coal. Here we wish to outline the principle issues around how a decline in oil production would affect the use of other energy carriers. The central point to be aware of is that the production and delivery of all fuels not only maintains the operational fabric of the globe, but is also part of, and dependent upon it.

The use of different energy vectors are tightly coupled. Oil is predominantly a transport fuel, however its demand is tied to production in the wider economy, which is dependent upon natural gas and coal via electricity production. The reverse is also true: a forced reduction in oil use would induce a system-wide reduction in electricity and heating use. They are also coupled within the energy production process itself: oil is used to transport coal and re-supply the infrastructure of natural gas and coal. The water required in much of the energy process and in electricity production is obtained by diverse fuels. At a wider level, all energy carriers interact to maintain the operational fabric. If this operational fabric fails, continued production, processing and distribution of all energy carriers may be imperilled. Reduced production in one energy carrier can cause a reduction in the others in a reinforcing feedback.

A fall in income for energy producers would reduce their ability to bring on new production and to maintain existing energy infrastructure. Because the exploration and development of all fossil fuels, renewable technologies, and nuclear power are on an upward path of higher energy and financial costs and operational complexity, they are particularly dependent on high real prices being maintained, and continual inputs of high complexity inputs.

For example, much future natural gas supplies (and coal) are expected to be produced from remote regions such as Siberia, requiring huge up front investments of fixed pipelines, which require long-term confidence in purchaser solvency and monetary stability. Other sources, in Qatar for example, will require a ramp-up of liquefaction/gasification plants and specialised ships. Again this requires huge upfront costs; and open supply-chain inputs to provide a complex infrastructure that in many cases is at the limits of current technology.

The likely inability of the global economy to re-boot will mean that potential supply may exceed demand for years. All the while, the loss of the operational fabric may mean potential future production becomes lost to the entropic decay of energy infrastructure and the diseconomies of scale in running large facilities with low volumes of production.

Usually when we talk of energy security we are in particular referring to the fuel. However the failure of the operational fabric might mean that fuel is available, but we cannot pay for it; the electric grid collapses; or repairs to the natural gas pipeline network cannot be maintained. Monetary collapse may mean all energy carriers are not traded except under barter type arrangements.

References

[56] Douthwaite, R. (1996) *Short Circuit: Strengthening Local Economies for Security in an Unstable World*. The Lilliput Press.

[57] Seabright, P. (2005) *The Company of Strangers: A Natural History of Economic Life*. Princeton Univ. Press.

[58] Soddy, F. (1926) *Wealth, Virtual Wealth and Debt: the Solution of the Economic Paradox*. George Allen & Unwin.

[59] *Key oil figures were distorted by US pressure, says whistleblower* Guardian 9th Nov.(2009).

[60] Godfray, H et. al. (2010) *Food Security: The Challenge of Feeding 9 Billion People*. Science Vol. 327.

[61] Smil, V. *(1999) Long-Range Perspectives on Inorganic Fertilizers in Global Agriculture*. International Fertilizer Development Centre.

SOME RIGHTS RESERVED This work is licensed under a Creative Commons Attribution-Share Alike 3.0 United States License.