The History of Money & Wealth

By Niall Douglas

The most recent issue of *Resurgence* spoke well of the problems with money and wealth, but did not address how this came to be in the first place. How was it that wealth became directly defined by an objective money value and maximising economic growth placed as the primary aim of government? A history of that process is most illustrative as it strongly suggests viable alternatives.

Economics may have been ruled by the Neo-Classical school for many decades now, but there has been substantial recent interest in Econophysics (the application of approaches from Physics to Economic problems). This yielded the 1997 Nobel prize in Economics for the Black-Scholes formula for options pricing, which any Corporate Finance student knows (and often hates!). Within this branch, there is a little known arcane sub-branch called *thermoeconomics* (the application of thermodynamic behaviour i.e.; energy flows to Economic problems). Today it lies in obscure and contradictory tatters, but it wasn't always like this – indeed, not only does it predate Econophysics itself, it can be argued that it is actually older than classical Economics which was begun by Adam Smith's *The Wealth of Nations* (1776).

Predating the Classical Economics school was the Physiocrat movement, typified by François Quesnay's *Tableau Économique* (1759) who believed that a nation's wealth was derived solely from agriculture – not that it was anti-industrial, but it didn't see the effects of labour specialisation and mass production in the way Smith made so central to his thesis. Throughout the 19th century, thermoeconomics remained a popular branch of economic study with the Neo-Classical father Stanley Jevons publishing an entire book in 1865 on the topic called *The Coal Question*. When reading this book today, one can substitute the word 'oil' for 'coal' and still get a better-than-average understanding of the problems facing us – for example, from this book the term "The Jevons Paradox" arose which says that rising prices for diminishing supplies of something really crucial can spur technological progress in extraction technologies which actually exponentially **increases** the rate of diminishment – and thus breaking the normal "invisible hand" of price signals guiding the market. Current economic belief *still* holds that rising oil prices will automatically reduce consumption, but I'd be willing to bet that consumption during peak oil will only be limited by the maximum rate of extraction and that the price is actually unimportant.

The rise in dominancy of the Neo-Classical school of Economics effectively killed off the classical thermoeconomics tradition by the start of the 20th century. Like most recent Economics, it was reformulated in statistical terms in Samuelson's *Foundations of Economic Analysis* (1947), progressed by Nicholas Georgescu-Roegen's *The Entropy Law and the Economic Process* (1971) and has remained that way since, with Jing Chen's *The Physical Foundation of Economics* (2005) being the most recent evolution[1]. But why did the Neo-Classical school so overcome its older uncle?

In 1871 Jevons himself fathered the modern formulation of marginal utility in his *The Theory of Political Economy* which became one of the fundamental mechanisms of the Neo-Classical school. It's worth explaining this theory a little: as a Benthamite, Jevons conceived of an absolute number denoting welfare which was determined by a combination of consumed goods and services. One then uses algebra to shuffle around the combinations of goods and services for each person so that overall social welfare is maximised for a given budget constraint. Jevons felt strongly that poverty, child labour and most especially lack of education were the main detractors from welfare, so he saw little problem with linking money wealth with welfare. After all, abject material poverty clearly diminishes happiness and this was rife in the 19th century. The huge advantage of Jevons' system was that for the first time, mathematical models of an economy could be constructed & manipulated and thus socially optimal policy decisions derived. Put simply, it made decision making **appear** more rigourous.

The problem with the Neo-Classical approach is that the restrictions required to make this internally consistent effectively treat all people and firms as perfectly rational clones and they also require both to have perfect knowledge of all potential future states (i.e.; that the market mechanism is infallible). One can easily see the effects of this perfectionisation of human beings as being the core cause of our current malaise – if the (free) market tends towards infallibility over the long-run, no one need worry about "temporary" blips. It also greatly downplays irrationality, emotion, spirituality, human relations and non-economic considerations outside increasing money wealth at all costs.

So what better does thermoeconomics offer? Thermoeconomics concentrates on the *process* rather than the mechanism of energy flow – which has the tremendous advantages of (i) treating economic systems holistically (i.e.; there is nothing callable as "waste") and (ii) directly utilising technological innovation. Neo-Classical Economics handles the first as 'externalities' and generally explains the second by assuming it to just automatically happen. Thermoeconomics is much more scientifically sound – where the Neo-Classical school assumes everything to tend toward

[1] This book by Chen is a particularly good example of just how badly Economists can understand Physics. Samuelson's Nobel prize winning speech rightly criticised this point, yet immediately (the next paragraph) went on to make the same error himself!

equilibrium in the long run, thermoeconomics recognises that everything tries to become *further* away from equilibrium in the long run. To understand this, one must delve into the tricky topic of entropy – for the purposes of this article, consider entropy to be a measure of quality or usefulness.

Entropy dissipation, for energy at least, is the effect on matter of the progression of time – indeed, thermal physics treats them as identical. When we say we consume energy, we really mean we consume the *quality* of energy (as energy equals mass, so if the planet didn't expel as much energy as it receives from the sun, it would gain mass over time – currently around 2kg of sunlight arrives per second). **All** mass, just by the virtue of existing, dissipates entropy i.e.; consumes energy quality, but how the mass is structured magnifies the effect of this consumption. A simple example will help – a typical personal computer will consume about 80-150W when turned on. In 2006, a typical high-end computer could perform around fifteen billion mathematical operations per second, but this value will double every eighteen months (and indeed has consistently done so for the last forty years or so, something called Moore's Law). Yet a personal computer generates exactly the same amount of heat as a 80-150W electric bar heater – so somehow, a computer is gaining something extra for "free". This is due to the differing structure of the computer, because the atoms making up its heating element (the silicon chips) are arranged in a certain way. Similarly, in eighteen months an improved structure will double the "free" effect of the same entropy dissipation.

In case you might think that this is just temporary, or artificially enabled by an exponentially rising consumption of fossil fuels, one should consider the history of planetary biodiversity and mass extinctions which is shown in figure 1. One can see a fairly obvious exponential rise in biodiversity, yet the rate of mass extinctions hasn't decreased by as much nor has the amount of sunlight reaching the planet risen by more than a small amount during the same time period. How is this possible unless life was becoming exponentially more efficient? This is further proven by the fact that biodiversity greatly increases during ice ages – more energy quality (i.e.; food) can be dissipated from sunlight when average temperatures are lower.

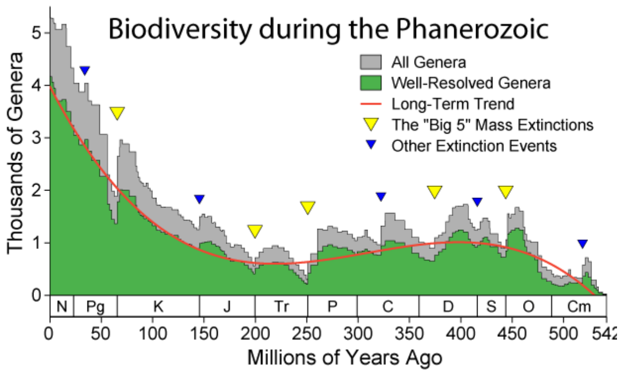

Figure 1: Biodiversity according to the Fossil record

One of the most confused, misunderstood and indeed humourous theoretical arenas is that of entropy dissipation – in few other areas does one see ordinarily intelligent and capable thinkers make such asses of themselves. Part of this is due to the difficult logical typing issues involved, some due to the confusing and unnatural terminology, but a lot is due to people trying to look intelligent talking about things they don't understand.

Nevertheless, there are some excellent books on the matter, one of the best in my opinion being Fritjof Capra in *The Web of Life* (1996) which is a synthesis of among others, earlier works such as Erich Jantsch's *The Self-Organising Universe* (1980) and Douglas Hofstadter's *Gödel Escher Bach – An Eternal Golden Braid* (1979). These books apply entropic principles to wider systems than just the Physics – for a technical Physics description without the philosophy, Kittel & Kroemer's Physics textbook *Thermal Physics* (1980) is just fine.

One notes that all these people were primarily trained in science, so they know when one thing is incommensurate with another (e.g.; energy entropy and information entropy). They also recognise that when you recourse to statistics, you are admitting that you don't know how the system you regress works – just that it has regularities, and you assume it keeps those regularities over time (which most organic systems do not for any significant period, as Paul Ormerod so clearly shows in his book *Butterfly Economics* [1998]). Almost the entirety of Macroeconomics is based on statistics, so much so that many lesser Economists confuse the statistical models with reality – much as lesser Physicists confuse the statistical thermodynamic models with reality – and I blame the modern mass-production education system entirely for this. Non-equilibrium Physics is fundamentally one of plasma behaviour, yet how many Physicists have heard of Hannes Alfvén, the only plasma physicist to ever win the Nobel prize for Physics? Despite his Nobel stature, he was repeatedly shunned by the academic community and refused publication in peer reviewed journals despite that many, if not most, of his theoretical predictions of solar system operation have since been proved by empirical research. The simple reason was that he, unlike most Physicists or Economists during the last century, assumed that far-from-equilibrium states were the norm, not the exception. Sadly, being correct is often punished.

With our much more modern understanding of non-linear and non-equilibrium behaviour, thermoeconomics may well retake the Economics limelight with a complete and full superset of the Neo-Classical model. A much fuller treatment of exactly what all this implies for how we should define our signifiers of wealth is more than possible – indeed, the original draft of this article exceeded 8,000 words and it barely skimmed the surface. Using this approach, one can not only prove that the unexpected success of capitalism was due to its unintended correspondence with entropic principles, but also to redefine money, financial structures, taxation, property, education, innovation – indeed, technological progress itself – to more closely align with the natural functioning of the Universe. Such a realignment not only can enable long-term **sustainable** double-digit growth rates[2], but also simultaneously suggest solutions for climate change and environmental degradation, the energy problem, social decay, crime and indeed the problem of human happiness which has eluded us for so long.

This may sound like snake oil – after all, how many people have promised panaceas which consist of nothing but straw? Well, it is no panacea – the same approach does nothing for wealth inequality, marginalisation and exploitation of the weak, resource grabs or the prevention of war, continuing large investments in military research or the meaningless futility of existence that so many experience. These issues are either unsolvable, or must await someone wiser than myself.

Many of you will now want to know a lot more detail. I would refer you to the books and papers already referred to, the sadly limited http://www.nedprod.com/NeoCapitalism/, the lecture videos at http://www.futuresociety.org.uk/, also the Centre for Social and Accounting Research here at St. Andrews (http://www.st-andrews.ac.uk/management/csear/). It is my intention to write down a lot of what is in my head for my PhD thesis for which I am currently sourcing funding – until then, my undergraduate degree must unfortunately take precedence. I will publish the original draft for this article at the Neo-Capitalism page when it's in a state for release.

I would appreciate comments, suggestions and corrections to this article. You can email me at XXX@xxx.xxx. I look forward to replying to you, but do note that there may be delays during term time as I can get extremely busy.

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[2] One cannot grow material production indefinitely, but one can grow knowledge and the efficiency of structures indefinitely – just as Gaia does.