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Envisioning a Successful Steady-State Economy¹

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Abstract

There are two interacting types of argument for a steady-state economy: its biophysical necessity, and its ethical desirability. The first argument is made in terms of the finitude, entropy, and physical maintenance requirements of "dissipative structures" (populations of human bodies and their exosomatic extensions). The second argument considers that the evolution of the human species is now purpose-driven, no longer random, if indeed it ever was. Purpose introduces value judgments of right and wrong regarding how our economy should relate to the rest of creation – judgments ignored by both neoclassical economics and neo-Darwinist naturalism.

How do you envision a successful economy without continuous growth?

It helps to consider a prior question: how do you envision a successful Planet Earth without continuous growth? That is easy to envision because it exists! The Earth as a whole does not grow in physical dimensions. Yet it changes qualitatively, it

1. An earlier short version of this essay was published in Daly, 2014.

evolves and develops. Total matter on Earth cycles, but does not grow. Energy from the sun flows through the earth coming in as low-entropy radiant energy, and exiting as high-entropy heat. But the solar flow is not growing. Nearly all life is powered by this entropic throughput of solar energy. There is birth and death, production and depreciation. New things evolve; old things go extinct. There is continual change. But the Earth is not growing.

The economy is a subsystem of the Earth. Imagine that the economy grows to encompass the entire earth. Then the economy would have to conform to the behavior mode of the Earth. Namely, it could no longer grow, and would have to live on a constant solar flow, approximating a steady state – an exceedingly large steady state to be sure, well beyond optimal scale. The economy would have taken over the management of the entire ecosystem – every amoeba, every molecule, and every photon would be allocated according to human purposes and priced accordingly. All ‘externalities’ would be internalized, and nothing could any longer be external to the all-encompassing economy. The information and management problem would be astronomical – central planning raised to the thousandth power! Long before such total takeover and complexity, the human economy and the civilization it supports would have collapsed.

To arrive at a vision that promises success we must discard some dead-end dreams – especially the just-mentioned dream of internalizing all biospheric relationships into the monetary accounts of the economy. To keep the economy manageable we must limit its physical scale relative to the containing ecosystem. The way to do that is to leave a large part of the ecosphere alone, to limit our absorption of it into the economic subsystem – to keep a large part of the earth ecosystem *in natura* – as a source for low-entropy matter/energy inputs and as a sink for high-entropy waste, and as a provider of life-support services, including services to non human species. Laissez faire takes on a new meaning – it is the ecosystem that must be left alone to manage itself and evolve by its own rules, while the economy is carefully constrained in aggregate scale to stay within the limits imposed by the ecosystem. Environmental sources and sinks necessarily must be used to support life and production, but the rate of use must remain within the regenerative and absorptive capacities of the ecosystem. The metabolic throughput from nature cannot keep growing. Limiting the physical throughput to sustainable levels will, by lowering supply, effectively internalize the external costs of excessive

scale. Resulting higher resource prices will improve the microeconomic efficiency of allocation.

Every encroachment of the economy into the ecosystem is a physical transformation of ecosystem into economy. Growth means less habitat for other species, with loss both of their instrumental value to the ecosystem, and the intrinsic value of their own sentient life. Clearly, in addition to a maximum scale of the economy relative to the ecosystem, there is also an optimal scale (much smaller), beyond which growth becomes uneconomic in the literal sense that it increases environmental and social costs faster than production benefits. We fail to recognize the uneconomic nature of growth beyond this point because we measure only production benefits and fail to measure environmental and social costs. We ignore the fact that 'illth' is a negative joint product with wealth. Examples of illth are everywhere, even if usually unmeasured in national accounts, and include: climate change from excess carbon in the atmosphere, radioactive wastes and risks of nuclear power, biodiversity loss, depleted mines, deforestation, eroded topsoil, dry wells, rivers, and aquifers, sea-level rise, the dead zone in the Gulf of Mexico, gyres of plastic trash in the oceans, the ozone hole, exhausting and dangerous labor, and the unrepayable debt from trying to push growth in the symbolic financial sector beyond what is possible in the real sector.

Growth all the way to the very limit of carrying capacity has an unrecognized political cost as well. Excess capacity is a necessary condition for freedom and democracy. Living very close to the carrying capacity limit, as on a submarine or spaceship, requires very strict discipline. On submarines and spaceships we have a captain with absolute authority, not a democracy. If we want democracy, we should not grow up to the limit of carrying capacity – better to leave some slack – some margin of tolerance for the errors that freedom entails.

The spatial boundaries across which we measure migration, and within which we measure natural increase (or decrease) are principally nation states. For some purposes it is the natural increase of the globe as a whole that is most relevant, and we can neglect migration, both international and "inter-planetary", even though the latter (e.g. terraforming Mars), while non-existent, is hailed by some as the future solution to overpopulation.

The Beatles musically longed for a “world without boundaries”, and we all know what they meant - a world of human solidarity, peace, and cooperation. Conflicts and war usually involve disputes over borders. So why not just get rid of these troublesome boundaries? Let’s have globalization – deregulated trade, capital mobility, and migration – only let’s bless them each with the adjective “free” rather than “deregulated”. Economists assure us that this will lead to peace and prosperity among rational utility-maximizing individuals, minimally governed by a benevolent World Democracy, dedicated to the post-modern values of secularist materialism, eloquently communicated in Esperanto. This vision has its serious appeal to many, but not so much to me. The anomaly of this cosmopolitan globalism, is that it is really individualism writ large – corporate feudalism in a global commons. Economic and political boundaries are necessary to achieve both national community, and a global federation of national communities living in peace and ecological sustainability.

Boundaries are both biologically and logically necessary. Skin and membranes are organic boundaries. Within-skin versus outside-skin is a basic boundary condition for life. The skin boundary must be permeable, but not too permeable. If nothing enters or exits the organism it will soon die. If everything enters and exits, then the organism is already dead and decaying. Life requires boundaries that are neither completely closed nor completely open. A nation’s borders are in many ways very different from the skin of an organism, yet neither permits complete closure or complete openness. Both must be qualitatively and quantitatively selective in what they admit and expel, if their separate existence is to continue rather than be dissolved entropically into its environment.

Logically boundaries imply both inclusion and exclusion. A world without boundaries includes everything and is often therefore thought to be warm and friendly. But “everything” must include the cold and the unfriendly as well, or it is not everything. Also, without boundaries, B can be both A and non-A, which makes definition, contradiction, and analytical reasoning impossible. So both life and logical thinking require boundaries. While “a world without boundaries” may be a poetic expression of a desired unity, and while it is possible to reason dialectically with overlapping boundaries, it is a major delusion to think that boundaries are not necessary.

It is understandable, yet ironic, that the most fundamental and dramatic boundary of all - that separating the earth from outer space – made clear in the iconic photo of the earth from the moon – seems to have led to a reaction against the very concept of boundaries on our spherical planet, since it is so obviously one whole and unified thing. Yet that beautiful and powerful vision of overall unity hides a world of diversity and difference. And we live on the earth, within that complex living diversity, not on the dead moon with no need for life-defining boundaries.

We need a non-growing economy that strives to maintain itself in a steady state within the boundary of its optimum scale. How to do that? Basically it is as simple (and difficult) as going on a diet. Cut the matter–energy throughput to a sustainable level by cap–auction–trade and/or ecological tax reform (taxing resource throughput – especially fossil fuels – rather than value added by labor and capital). We should cap or tax fossil fuels first. Then redistribute auction or eco-tax revenues by cutting income taxes for all, but first and mainly for the poor. A policy of quantitative limits on throughput (cap–auction–trade) raises resource prices and induces resource-saving technologies. The quantitative cap will also block the erosion of resource savings as induced efficiency makes resources effectively cheaper (the Jevons effect). In addition, the auction will raise much revenue and make it possible to tax value added (labor and capital) less, because in effect we will have shifted the tax base to resource throughput. Value added is a good, so we should stop taxing it. Depletion and pollution are bads, so we should tax them.

Along with a physical diet, we need a serious monetary diet for the obese financial sector, specifically movement away from fractional reserve banking toward a system of 100 percent reserve requirements. This would end the private banks' alchemical privilege to create money out of nothing and lend it at interest. Every dollar loaned would then be a dollar that someone previously saved, restoring the classical balance between abstinence and investment. This balance was abandoned by the Keynesian–neoclassical synthesis after the Great Depression because it was thought to be a drag on growth, the new panacea. But in the new era of uneconomic growth the classical discipline regains its relevance. Investors must choose only the best projects, thereby improving the quality of growth while limiting its quantity. This idea of 100 percent reserve requirements on demand deposits was championed by the early Chicago School in the 1930s, as well as

by Irving Fisher of Yale, and probably first proposed in 1926 by Frederick Soddy, Nobel Prize-winning chemist and underground economist. Also, a small, so-called 'Tobin tax, on all financial trades would reduce speculative and destabilizing short-term trading (including algorithm-based computer trading on fraction of a second price differences) and raise significant revenue.

What about population growth? If I can manage to live for a few more years the world population will have quadrupled in my lifetime (from 2 to 8 billion), and the populations of other 'dissipative structures' (cars, houses, livestock, cell phones, and so on) will have more than quadrupled. Limiting the populations of artifacts by capping the metabolic throughput ("food supply") that sustains them seems a good policy. However, limiting food supply to humans is nature's harsh limit, Malthus' positive check. There is also Malthus' preventive check (celibacy and late marriage), and the more palatable neo-Malthusian preventive check of contraception. Contraceptives should be made easily available for voluntary use everywhere.

More people are better than fewer, but not if all are alive at the same time. Population has a temporal as well as a spatial boundary. We should strive to maximize the cumulative number of people ever to live over time in a condition of sufficiency. That means no more people alive at the same time than could enjoy a per capita resource availability that is enough for a good (not luxurious) life, and sustainable for a long (not infinite) future. Exactly how many people at exactly what per capita standard would that be? We do not know, but we do know that it is not more people at a higher per capita consumption, and that is enough to get started in the right direction. For a nation's population not to grow necessarily requires that births plus immigrants equal deaths plus emigrants. A further condition, not logically necessary but politically desirable, is that every birth be a wanted birth and every immigrant a legal immigrant.

The population problem should be considered from the point of view of all populations of the human world – populations of both us humans and our things (cars, houses, livestock, crops, cell phones, etc.) – in short, populations of all "dissipative structures" engendered, bred, or built by humans. Both human bodies and artifacts wear out and die. The populations of all organs that support human life, and the enjoyment thereof, require a metabolic throughput to counteract entropy and remain in an organized quasi-steady state. All of these

organs are capital equipment that support our lives. Endosomatic (within skin) capital – heart, lungs, kidneys – supports our lives quite directly. Exosomatic (outside skin) capital supports our lives indirectly, and consists both of natural capital (e.g., photosynthesizing plants, structures comprising the hydrologic cycle), and manmade capital (e.g., farms, factories, electric grids).

In a physical sense, the final product of the economic activity of converting nature into ourselves and our stuff, and then using up or wearing out what we have made, is waste (Georgescu-Roegen, 1971)². Ultimately that is our “ecological footprint”. What keeps this from being an idiotic activity—depleting and polluting, grinding up the world into waste—is the fact that all these populations of dissipative structures have the common purpose of supporting the maintenance and enjoyment of life. As John Ruskin said, “*there is no wealth but life.*”

Ownership of endosomatic organs is equally distributed among individuals (absent slavery), while the ownership of exosomatic organs is not, a fact giving rise to social conflict. Control of these external organs may be democratic or dictatorial. Our lungs are of little value without the complementary natural capital of green plants and atmospheric stocks of oxygen. Owning one’s own kidneys is not enough to support one’s life if one does not have access to water from rivers, lakes, or rain, either because of scarcity or monopoly ownership of the complementary exosomatic organ. Therefore all life-supporting organs, including natural capital, form a unity with a common function, regardless of whether they are located within the boundary of human skin or outside that boundary.

Our standard of living is traditionally measured by the ratio of manmade capital to human beings—that is, the ratio of one kind of dissipative structure to another kind. Human bodies are made and maintained overwhelmingly from renewable resources, while capital equipment relies heavily on nonrenewable resources as well. The rate of evolutionary change of endosomatic organs is exceedingly slow; the rate of change of exosomatic organs has become very rapid. In fact the

2. Waste is too neutral a term. In fact annual production of goods that accumulate into a stock of wealth requires the joint production of “bads” that accumulate into a stock of “illth”. The negative terms are absent from the indexes of economics textbooks, and unsubtracted in national accounts. A stock of wealth requires the joint production of “bads” that accumulate into a stock of “illth”. The negative terms are absent from the indexes of economics textbooks, and unsubtracted in national accounts.

collective evolution of the human species is now overwhelmingly centered on exosomatic organs. We fly in airplanes and rockets, not with wings of our own. This exosomatic evolution is goal-directed, not random. Its driving purpose has become “economic growth,” and that growth has been achieved largely by the depletion of the earth’s resources and pollution of its spaces.

Although human evolution is now decidedly purpose-driven, we continue to be enthralled by neo-Darwinist aversion to teleology and devotion to random processes. Economic growth, by promising more for everyone, becomes the *de facto* purpose, the social glue that keeps things from falling apart. But what happens when growth becomes uneconomic, when it begins to increase environmental and social costs faster than production benefits? How do we know that this is not already the case? Studies suggest that it is.³ If one asks such questions, as Pope Francis is doing, one is usually told to talk about something else, like space colonies on Mars, or unlimited energy from cold fusion, or geo-engineering, or the wonders of globalization, and to remember that all these glorious purposes require growth, in order to provide still more growth in the future. Growth is the *summum bonum* – end of discussion!

In the light of these considerations, let us reconsider the idea of demographic transition. By definition this is the transition from a human population maintained by high birth rates equal to high death rates, to one maintained by low birth rates equal to low death rates, and consequently from a population with low average lifetimes to one with high average lifetimes. Statistically such transitions have often been observed as standard of living increases. Many studies have attempted to explain this correlation, and much hope has been invested in it as an automatic cure for overpopulation. “Development is the best contraceptive” is a related slogan, partly based in fact, and partly in wishful thinking.

3. See concepts of Index of Sustainable Economic Welfare, Genuine Progress Indicator, Global Footprint (Daly, 2015). More recently The Lancet Commission on Pollution and Health finds that the financial costs from pollution are some \$4.6 trillion annually, about 6.2% of the global economy (Landrigan et al 2017). If annual growth in Gross World Product is around 2.2%, and cost due to pollution is 6.2%, then with reasonable accounting we would have a net financial decline of some 4% annually. If that financial decline represents welfare loss, and it surely does since we are talking about reduced health and life expectancy, then the benefits of production growth are being more than cancelled out by the costs of the pollution generated by that growth. In other words, so-called “economic” growth has become uneconomic at the present margin. So far that seems to have escaped the notice of most economists!

There are a couple of thoughts I'd like to add to the discussion of demographic transition. The first and most obvious one is that populations of artifacts can undergo an analogous transition from high rates of production and depreciation to low ones. The lower rates will maintain a constant population of longer-lived, more durable artifacts. Our economy has a GDP-oriented focus on maximizing production flows (birth rates of artifacts) that keeps us in the pre-transition mode, giving rise to low product lifetimes, planned obsolescence, and high resource throughput, with consequent environmental destruction. The transition from a high maintenance throughput to a low one applies to both human and artifact populations independently. From an environmental perspective, lower throughput per unit of stock (longer human and product lifetimes) is desirable in both cases, at least up to some distant limit.

The second thought I would like to add is a question: does the human demographic transition, when induced by rising standard of living⁴, as usually assumed, increase or decrease the total load of all dissipative structures on the environment? Specifically, if Indian fertility is to fall to the Swedish level, must Indian per capita possession of artifacts (standard of living) rise to the Swedish level? If so, would this not likely increase the total load (ecological footprint) of all dissipative structures on the Indian environment, perhaps beyond capacity to sustain the required throughput?

The point of this speculation is to suggest that "solving" the population problem by relying on the demographic transition to lower birth rates could impose a larger burden on the environment, rather than the smaller burden hoped for⁵. Of course indirect reduction in fertility by automatic correlation with rising standard of living is politically easy, while direct fertility reduction is politically very difficult. But what is politically easy may be environmentally ineffective.

Even if we limit quantitative physical throughput (growth) it would still be possible to experience qualitative improvement (development), thanks to technological

4. An earlier writer, defined standard of living as "the number of desires that take precedence in the individual choice over the effective desire for offspring" (Carver, 1924. p. 34) , thus anticipating the basic idea of the demographic transition.

5. This is an empirical question. Is fertility being reduced to make room mainly for cars and refrigerators, or for parks and leisure?

advance and to ethical improvement of our priorities. Some say that we should not limit growth itself, but only stop bad growth and encourage good growth. However, only if we limit total growth will we be forced to choose good growth over bad. And furthermore, we can also have too much 'good' growth, or as it is often called 'green growth'. There is a limit to how many trees we can plant as well as to how many cars we can make. Growth beyond optimal scale is uneconomic growth, and we should stop the folly of continuing it.

If you are an optimist regarding 'soft' technologies (for example, conservation, solar) please have the courage of your convictions and join in advocating these policies that will give incentive to the resource-saving technologies that you believe are within reach. You may be right – I hope you are. Let us find out. If you turn out to be wrong, there is really no downside, because it was still necessary to limit throughput and consequently the 'hard' resource-intensive technologies (for example, fossil fuel, nuclear) that are currently pushing uneconomic growth.

Our strategy so far has been to seek efficiency first in order to avoid frugality – to keep the throughput growing. But 'efficiency first' leads us to the Jevons paradox – we just consume more of the resources whose efficiency we have increased, thereby partially or even totally cancelling the initial reduction in quantity of resource used. If we impose 'frugality first' (caps on basic resource throughput), then we will get 'efficiency second' as an induced adaptation to frugality, avoiding the Jevons paradox. Blocking the Jevons paradox is an advantage of the cap–auction–trade system over eco-taxes, although taxes have the advantage of being administratively simpler. Both will work.

Is this vision of a developing but non-growing economy not more appealing and realistic than the deceptive dream of an economy based on continuous growth? Who, in the light of biophysical reality, can remain committed to the growth-forever vision? Apparently our decision-making elites can. They have figured out how to keep the dwindling extra benefits of growth for themselves, while 'sharing' the exploding extra costs with the poor, the future, and other species. The elite-owned media, the corporate-funded think tanks, and the kept economists of high academia, Wall Street, and the World Bank, all sing hymns to growth in perfect unison, deceiving average citizens, and perhaps themselves. Their commitment is not to maximize the cumulative number of people ever to live at a sufficient

standard of consumption for a good life for all. Rather, it is to maximize the standard of resource consumption for a small minority of the present generation, and let the costs fall on the poor, the future, and other species.

Some of the elite do not realize the cost of their behavior and will change once they are made aware. Others, I suspect, are already quite aware and do not care. The former can be persuaded by argument; the latter require repentance and conversion – or revolution, as Marxists would argue. Probably this line of division in some way runs through each of us rather than only between us. Intellectual confusion is real and we need better understanding, but that is not the whole story. The elite may already understand that growth has become uneconomic. But they have adapted by learning how to keep the dwindling extra benefits of growth, while ‘sharing’ the rising extra costs.

Indeed why not, if we believe that Creation is just a purposeless happenstance, the random consequence of multiplying infinitesimal probabilities by an infinite number of trials, as taught by the reigning worldview of naturalism? I say Creation with a capital ‘C’ advisedly, certainly not in denial of the established facts of evolution, but rather in protest to the metaphysical naturalism widespread among the intelligentsia, that all is purposeless happenstance. It is hard to imagine, under such a vision, from where the elite, or anyone else, would get the inspiration to care for Creation, which of course naturalists would have to call by a different name, say, ‘Randomdom’. Imagine calling on people to work hard and sacrifice to save ‘Randomdom’ – the blind result of Epicurus’ atoms swirling and swerving in the void! Intellectual confusion is real, but the moral nihilism logically entailed by the naturalistic scientism uncritically accepted by so many, may be the bigger problem.

The working hypothesis of scientific materialism, because it is so fruitful and widely accepted, is also constantly tempted to imperially morph into an Ultimate Metaphysics - albeit a metaphysics of Chance. However, explaining everything by chance is close to having no explanation at all. Simply adding Darwinian natural selection to Mendelian random mutation does not really mitigate the dominance of chance, because the selective criteria of environmental conditions (other organisms and geophysical surroundings) is also considered to be a random product of chance. Mutations provide random change in the genetic menu from

which natural selection picks according to adaptive survival odds determined by a randomly changing environment. Many of us would insist that purpose is also causative in the physical world, and is non-random. Given purpose, change in the environment is not entirely random, and given modern genetics even mutation is no longer entirely random. However, a historical animus against teleology of any kind leads Neo-Darwinists to affirm that purpose or free will is reducible to deterministic biophysics, and that any direct subjective experience of purpose, or reasoned decision-making in pursuit of a purpose, is an "illusory epiphenomenon." It is hard to square empiricism with such a cavalier rejection of our most immediate and direct experience, that of purpose. If reason and purpose are illusory, then so is policy. Logically Neo-Darwinist biologists must be even more *laissez-faire* than Neo-Classical economists. Economists at least recognize purpose as causative, but traditionally refuse to pass ethical judgment (the individual consumer's purposes are sovereign). Biologists, or at least Neo-Darwinist materialists, deny the independent causality of purpose and therefore must consider it meaningless to pass ethical judgment on "choices" that from their perspective could not have been otherwise.

When contemplating the meaninglessness implicit (and increasingly explicit) in their materialist cosmology, some scientists seem to flinch, and look for optimism somewhere within their materialism. They invent the hypothesis of infinitely many (unobservable) universes in which life may outlive our universe. They were led to this extraordinary idea in order to escape the implications of the anthropic principle – which argues that for life to have come about by chance in our single universe would require far too many just-so coincidences. To preserve the idea of chance as reasonable cause, and thereby escape any notion of Creator, they argue that although these coincidences are indeed overwhelmingly improbable in a single universe, they would surely happen if there were infinitely many universes. And of course our universe is obviously the one in which the improbable events all happened. If you don't believe that Shakespeare wrote Hamlet, you can claim that infinitely many monkeys tapping away at infinitely many typewriters had to hit upon it someday.

Such a Metaphysics of Chance precludes explanation of some basic facts: first, that there is something rather than nothing; second, the just-right physical "coincidences" set forth in the anthropic principle; third, the "spontaneous

generation” of first life from inanimate matter before evolution can get started; fourth, the creation of an incredible amount of specified information in the genome of all the irreducibly complex living creatures that grew from the relatively simple information in the first living thing (neglecting that random change destroys rather than creates information); fifth, the emergence of self-consciousness and rational thought itself (if my thoughts are ultimately the product of random change, why believe any of them, including this one?); and sixth, the innate human perception of right and wrong, of good and bad, which would be meaningless in a purely material world. Explaining these facts “by chance” strains credulity even more than “by miracle”.

It seems that a sustainable steady-state economy, as a policy of Creation care, will not get far in a world dominated by naturalism. Naturalism denies the premises underlying policy of any kind, namely that our purposes are causative in the physical world, that Creation is not random, that our reason is capable of understanding its order, and that we can distinguish good from bad. There are many political roadblocks to a steady-state economy, but the most fundamental barrier is the metaphysical dogma of naturalism that logically, but blindly, aborts the possibility of policy of any kind.

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