VALUING THE EARTH: Economics, Ecology, Ethics

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[p. 267] Sustainable Growth: An Impossibility Theorem

Impossibility statements are the very foundation of science. It is impossible to: travel faster than the speed of light; create or destroy matter-energy; build a perpetual motion machine, etc. By respecting impossibility theorems we avoid wasting resources on projects that are bound to fail. Therefore economists should be very interested in impossibility theorems, especially the one to be demonstrated here, namely that it is impossible for the world economy to grow its way out of poverty and environmental degradation. In other words, sustainable growth is impossible.

In its physical dimensions the economy is an open subsystem of the earth ecosystem, which is finite, nongrowing, and materially closed. As the economic subsystem grows it incorporates an ever greater proportion of the total ecosystem into itself and must reach a limit at 100 percent, if not before. Therefore its growth is not sustainable. The term "sustainable growth" when applied to the economy is a bad oxymoron—self-contradictory as prose, and unevocative as poetry.

Challenging the Economic Oxymoron

Economists will complain that growth in GNP is a mixture of quantitative and qualitative increase and therefore not strictly subject to physical laws. They have a point. Precisely because quantitative and qualitative change are very different it is best to keep them separate and call them by the different names already provided in the dictionary. To grow means "to increase naturally in size by the addition of material through assimilation or accretion." To develop means "to expand or realize the potentialities of; to bring gradually to a fuller, greater, or better state." When something grows it gets bigger. When something develops it gets different. The earth ecosystem develops (evolves), but does not grow. Its subsystem, the economy, must eventually stop growing, but can continue to develop. The term "sustainable development" therefore makes sense for the economy, but only if it is understood as "development without growth"—i.e., qualitative improvement of a physical economic base that is maintained in a steady state by a throughput of matter-energy that is within the regenerative and assimilative capacities of the ecosystem. Currently the term "sustainable development" is used as a synonym for the oxymoronic "sustainable growth." It must be saved from this perdition.

Politically it is very difficult to admit that growth, with its almost religious connotations of ultimate goodness, must be limited. But it is precisely the nonsustainability of growth that gives urgency to the concept of sustainable development. The earth will not tolerate the doubling of even one grain of wheat 64 times, yet in the past two centuries we have developed a culture dependent on exponential growth for its economic stability (Hubbert, 1976). Sustainable development is a cultural adaptation made by society as it becomes aware of the emerging necessity of nongrowth. Even "green growth" is not sustainable. There is a limit to the population of trees the earth can support, just as there is a limit to the populations of humans and of automobiles. To delude ourselves into believing that growth is still possible and desirable if only we label it "sustainable" or color it "green" will just delay the inevitable transition and make it more painful.

Limits to Growth?

If the economy cannot grow forever then by how much can it grow? Can it grow by enough to give everyone in the world today a standard of per capita resource use equal to that of the average American? That would turn out to be a factor of seven,*I a figure that is neatly bracketed by the Brundtland Commission's call (Brundtland et al., 1987) for the expansion of the world economy by a factor of five to ten. The problem is that even expansion by a factor of four is impossible if Vitousek et al. (1986, pp. 368-373) are correct in their calculation that the human economy currently preempts one-fourth of the global net primary product of photosynthesis (NPP). We cannot go beyond 100 percent, and it is unlikely that we will increase NPP since the historical tendency up to now is for economic growth to reduce global photosynthesis. Since land-based ecosystems are the more relevant, and we preempt 40 percent of land-based NPP, even the factor of four is an overestimate. Also, reaching 100 percent is unrealistic since we are incapable of bringing under direct human management all the species that make up the ecosystems upon which we depend. Furthermore it is ridiculous to urge the preservation of biodiversity without being willing to halt the economic growth that requires human takeover of places in the sun occupied by other species.

If growth up to the factor of five to ten recommended by the Brundtland Commission is impossible, then what about just sustaining the present scale -- i.e., zero net growth? Every day we read about stress-induced feedbacks from the ecosystem to the economy, such as greenhouse buildup, ozone layer depletion, acid rain, etc., which constitute evidence that even the present scale is unsustainable. How then can people keep on talking about "sustainable growth" when: (a) the present scale of the economy shows clear signs of unsustainability, (b) multiplying that scale by a factor of five to ten as recommended by the Brundtland Commission would move us from unsustainability to imminent collapse, and (c) the concept itself is logically self-contradictory in a finite, nongrowing ecosystem? Yet sustainable growth is the buzz word of our time. Occasionally it becomes truly ludicrous, as when writers gravely speak of "sustainable growth in the rate of increase of economic activity." Not only must we grow forever, we must accelerate forever! This is hollow political verbiage, totally disconnected from logical and physical first principles.

Alleviating Poverty, Not Angelizing GNP

The important question is the one that the Brundtland Commission leads up to, but does not really face: How far can we alleviate poverty by development without growth? I suspect that the answer will be a significant amount, but less than half. One reason for this belief is that if the five- to tenfold expansion is really going to be for the sake of the poor, then it will have to consist of things needed by the poor—food, clothing, shelter—not information services. Basic goods have an irreducible physical dimension and their expansion will require growth rather than development, although development via improved efficiency will help. In other words, the reduction in resource content per dollar of GNP observed in some rich countries in recent years cannot be heralded as severing the link between economic expansion and the environment, as some have claimed. Angelized GNP will not feed the poor. Sustainable development must be development without growth—but with population control and wealth redistribution—if it is to be a serious attack on poverty.

In the minds of many people, growth has become synonymous with increase in wealth. They say that we must have growth to be rich enough to afford the cost of cleaning up and curing poverty. That all problems are easier to solve if we are richer is not in dispute. What is at issue is whether growth at the present margin really makes us richer. There is evidence that in the US it now makes us poorer by increasing costs faster than it increases benefits (Daly and Cobb, 1989, appendix). In other words we appear to have grown beyond the optimal scale.

Defining the Optimal Scale

The concept of an optimal scale of the aggregate economy relative to the ecosystem is totally absent from current macroeconomic theory. The aggregate economy is assumed to grow forever. Microeconomics, which is almost entirely devoted to establishing the optimal scale of each microlevel activity by equating costs and benefits at the margin, has neglected to inquire if there is not also an optimal scale for the aggregate of all micro activities. A given scale (the product of population times per capita resource use) constitutes a given throughput of resources and thus a given load on the environment, and can consist of many people each consuming little, or fewer people each consuming correspondingly more.

An economy in sustainable development adapts and improves in knowledge, organization, technical efficiency, and wisdom; and it does this without assimilating or accreting, beyond some point, an ever greater percentage of the matter-energy of the ecosystem into itself, but rather stops at a scale at which the remaining ecosystem (the environment) can continue to function and renew itself year after year. The nongrowing economy is not static—it is being continually maintained and renewed as environment.

What policies are implied by the goal of sustainable development, as here defined? Both optimists and pessimists should be able to agree on the following policy for the US (sustainable development should begin with the industrialized countries). Strive to hold throughput constant at present levels (or reduced truly sustainable levels) by taxing resource extraction, especially energy, very heavily. Seek to raise most public revenue from such resource severance taxes, and compensate (achieve revenue neutrality) by reducing the income tax, especially on the lower end of the income distribution, perhaps even financing a negative income tax at the very low end. Optimists who believe that resource efficiency can increase by a factor of ten should welcome this policy, which raises resource prices considerably and would give powerful incentive to just those technological advances in which they have so much faith. Pessimists who lack that technological faith will nevertheless be happy to see restrictions placed on the size of the already unsustainable throughput. The pessimists are protected against their worst fears; the optimists are encouraged to pursue their fondest dreams. If the pessimists are proven wrong and the enormous increase in efficiency actually happens, then they cannot complain. They got what they most wanted, plus an unexpected bonus. The optimists, for their part, can hardly object to a policy that not only allows but gives a strong incentive to the very technical progress on which their optimism is based. If they are proved wrong at least they should be glad that the throughput-induced rate of environmental destruction has been slowed. Also severance taxes are harder to avoid than income taxes and do not reduce incentives to work.

At the project level there are some additional policy guidelines for sustainable development. Renewable resources should be exploited in a manner such that:

1. Harvesting rates do not exceed regeneration rates.
2. Waste emissions do not exceed the renewable assimilative capacity of the local environment.

Balancing Nonrenewable and Renewable Resources.

Nonrenewable resources should be depleted at a rate equal to the rate of creation of renewable substitutes. Projects based on exploitation of nonrenewable resources should be paired with projects that develop renewable substitutes. The net rents from the nonrenewable extraction should be separated into an income component and a capital liquidation component. The capital component would be invested each year in building up a renewable substitute. The separation is made such that by the time the nonrenewable is exhausted, the substitute renewable asset will have been built up by investment and natural growth to the point where its sustainable yield is equal to the income component. The income component will have thereby become perpetual, thus justifying the name "income," which is by definition the maximum available for consumption while maintaining capital intact. It has been shown (El Serafy, 1989, pp. 10-18) how this division of rents into capital and income depends upon: (1) the discount rate (rate of growth of the renewable substitute); and (2) the life expectancy of the nonrenewable resource (reserves divided by annual depletion). The faster the biological growth of the renewable substitute and the longer the life expectancy of the nonrenewable, the greater will be the income component and the less the capital set-aside. "Substitute" here should be interpreted broadly to include any systemic adaptation that allows the economy to adjust the depletion of the nonrenewable resource in a way that maintains future income at a given level (e.g., recycling in the case of minerals). Rates of return for the paired projects should be calculated on the basis of their income component only.

However, before these operational steps toward sustainable development can get a fair hearing, we must first take the conceptual and political step of abandoning the thought-stopping slogan of "sustainable growth."

Note

*1. Consider the following back-of-the-envelope calculation, based on the crude estimate that the US currently uses 1/3 of annual world resource flows (derived from National Commission on Materials Policy, 1973). Let R be current world resource consumption. Then R13 is current US resource consumption, and R/3 divided by 250 million is present per capita US resource consumption. Current world per capita resource consumption would be R divided by 5.3 billion. For future world per capita resource consumption to equal present US per capita consumption, assuming constant population, R must increase by some multiple, call it M. Then M times R divided by 5.3 billion must equal R/3 divided by 250 million. Solving for M gives 7. World resource flows must increase sevenfold if all people are to consume resources at the present US average. But even the sevenfold increase is a gross underestimate of the increase in environmental impact, for two reasons. First, because the calculation is in terms of current flows only with no allowance for the increase in accumulated stocks of capital goods necessary to process and transform the greater flow of resources into final products. Some notion of the magnitude of the extra stocks needed comes from Harrison Brown's estimate that the "standing crop" of industrial metals already embodied in the existing stock of artifacts in the ten richest nations would require more than 60 years' production of these metals at 1970 rates. Second, because the sevenfold increase of net usable minerals and energy will require a much greater increase in gross resource flows, since we must mine ever less accessible deposits and lower grade ores. It is the gross flow that provokes environmental impact.

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