NPG Forum

The Steady-State Economy: What It Is, Why We Need It

by John Attarian

Viewed superficially, humanity's material condition and prospects have never looked better. Modernization and affluence are unprecedentedly democratized. A more penetrating examination, however, reveals that humanity is hideously vulnerable, that its present course cannot long endure, and that a radically different type of economy is urgently needed.

I. Our Growth Economy is Unsustainable

Evidence is accumulating that resources are finite, that we are degrading the environment which supports us, and that our demands on it are too great to maintain for much longer.

The quantity of accessible fresh water is no greater than it was when human life began, and our demands on it are rising relentlessly. With over 1.3 billion people and a hectically growing economy, China has a worsening water crisis. The shallow aquifer under the North China Plain, where about a third of China's corn and over half its wheat are grown, is depleted. China is tapping the plain's deep aquifer of irreplaceable prehistoric water. Of China's 668 cities, 400 have water shortages. Annual per capita water supply is about 2,200 cubic meters, one-fourth the world average. By 2030, when China's population is projected to reach 1.6 billion, it will be 1,700 cubic meters, an "alarm level" by world standards.[1]

Other countries, including Pakistan, the United States, Mexico, Saudi Arabia and Iran are also draining their aquifers faster than they are recharging. Mexico City has subsided thirty feet in the past century, and in places sinks a foot a year, from aquifer depletion. American rivers such as the Colorado are being drained dry.[2]

Humanity is similarly dependent upon, and rapidly depleting, the world's oil. In 1949 geophysicist M. King Hubbert reasoned that since fossil fuels were created in geologic time and their supply is therefore fixed and finite, annual extraction of a fossil fuel must start at zero, rise exponentially at first, pass through one or more maxima, and then decline to zero. He predicted in 1956 that oil extraction in America's lower 48 states would peak in 1970. It did.[3]

Applying Hubbert's approach, several geologists argue that world oil extraction will peak in this decade and then irreversibly decline, making supply no longer able to meet demand.[4] Two trends powerfully support them. First, as time has passed, more and more oil-producing countries have peaked, strongly indicating an imminent peak. Of the 48 countries producing 98 percent of the world's oil, 31 have peaked: three in 1961-1970; eleven in 1971-1980; two in 1981-1990; twelve in 1991-2000; and three in 2001 alone. Second, oil discovery peaked in 1964 and has declined ever since, and has fallen increasingly short of consumption since 1981.[5] Since discovery cannot replace existing oilfields, peak is inevitable.

Natural gas is vital for generating electric power and producing nitrogen fertilizer. American gas extraction peaked in 1973. Our gas wells are depleting rapidly, as much as 50 percent (in some cases 83 percent) in the first year of production. We are drilling thousands of wells to compensate; yet output relentlessly falls. Imports, almost all from Canada, accounted for 4.4 percent of American gas consumption in 1981, and 16.2 percent in 2002. Our imports took 56 percent of Canada's extraction in 2002. Unfortunately, Canada's gas is depleting too. North America will soon be unable to supply its own gas needs. Imports of liquefied natural gas (LNG) will be the only other source. Our capacity to import LNG is small.[6]

Many fish stocks have collapsed from overfishing. The United Nations' Food and Agricultural Organization reported that as of 2000, roughly 47 percent of the main marine fish stocks or species groups were "fully exploited," i.e., yielding catches at or near their sustainable limits. Another 18 percent are "overexploited": fish are being caught faster than they can reproduce, so the stocks are likely to decline and yield diminishing catches. Finally, 10 percent are either substantially depleted or recovering from depletion. In short, 75 percent of oceanic fish stocks are either at maximum sustainable yield, or have been fished into actual or incipient collapse.[7]

The appearance of oceanic "dead zones"--areas of coastal water that are too oxygen-poor to support marine life--proves that we are dumping more nitrogen into the ecosystem than it can absorb. Entering these waters from fertilizers borne by runoff, from combustion of fossil fuels, and from human wastes, the nitrogen promotes algae blooms, which sink and decompose, using up the water's oxygen. Dead zones have been multiplying since the 1960s, and have doubled since 1990. As of 2000, there were 146 zones, clustered along coasts housing large human populations or river mouths carrying large amounts of nitrogen into the ocean.[8]

We are overloading the ecosystem with carbon dioxide, too. Before the Industrial Revolution, the atmospheric concentration of CO2 was 280 parts per million. As of 2002, it was 372.3 ppm, or 33 percent higher. The rising concentration of carbon dioxide and other greenhouse gases is raising Earth's surface temperature, causing ice melt in the Himalayas, the North Pole, Antarctica, and elsewhere.[9]

This overburdening of the environment means economic growth cannot continue for long, and that maintaining current living standards long-term, let alone universalizing affluence, is impossible.

Economist Herman Daly, founding father of ecological economics, warned of this decades ago. Since the facts vindicate him, Daly's economics invite attention.

II. Essentials of Ecological Economics

Whereas mainstream economics either ignores the economy's relation to the environment or assumes that the environment is a subset of the economy, i.e., the extractive industry (mining, energy, etc.), Daly maintains that the economy is a subset of the ecosystem, which is finite, non-growing, and materially closed--no matter enters or leaves it. The ecosystem is a *source* of the economy's resources, and a *sink* for its wastes. Energy and matter enter the economy as inputs, are transformed into goods and services, and leave as wastes, this flow of energy and matter being known as "throughput."[10]

Daly draws on Nicholas Georgescu-Roegen's *The Entropy Law and the Economic Process* (1971), which explained the economic significance of the second law of thermodynamics (entropy law): in an energetically closed system (no energy enters or leaves), the availability of useful energy always declines. The economic process transforms matter-energy from a state of low entropy to a state of high entropy. The entropy law implies that matter can be recycled only partially, and that energy cannot be recycled at all and can be used only once. It also implies that creating order through producing manmade capital entails creating greater disorder elsewhere in the environment--too much of which will make the environment unable to support human life. The entropy law thus severely limits what we can do, and implies limits to growth.[11]

Ecological interdependence limits growth, too. The environment provides vital services which excessive economic growth removes. Forests help hold topsoil in place, preventing erosion; help absorb rainwater, preventing floods and transmitting the water elsewhere; take carbon dioxide out of the atmosphere; and so on--valuable benefits which deforestation eliminates.[12]

Resource finitude necessarily implies that worldwide attainment of American affluence is impossible, and that even if it could be attained it could not last. Daly points out that universalizing American per capita resource consumption would take even more resources, because processing the larger resource flow would require a much larger capital stock--which, of course, is made of resources.[13]

Mainstream economics treats factors of production as substitutes. That is, if we have less of one factor (labor, say), we can add more of another (machinery) and still produce the same output. Daly argues that natural capital (resources) and man-made capital (machines, tools, buildings, etc.) are complements, not substitutes: they must be used together in essentially fixed proportions, so that adding more of one cannot compensate for having less of the other. We cannot offset a dwindling supply of natural capital by adding more manmade capital (which itself is produced from natural capital!). Indeed, having less of a complementary input means the output must be smaller. For example, if the supply of lumber declines, we cannot just add more hammers and still build a house; without enough lumber, the house cannot get built. A crucial implication of input complementarity is that since the quantity of output is proportional to the quantities of inputs, the input which is in shortest supply is the *limiting factor*--i.e., the factor which determines how much output can be made.[14] If we have enough hammers and saws to build three houses, but enough lumber for two, then only two houses can get built, making lumber the limiting factor. The common sense and realism of all this is obvious.

When the world was "empty" (the economy was small relative to the ecosystem), man-made capital was the limiting factor. Thus, when trees were abundant, the supply of axes, saws, and sawmills determined how much lumber could be produced at a given time; when cod were plentiful off the coasts of New England and Canada, the number and capacity of fishing boats determined the catch size. Now, however, Daly argues, the factors' roles have reversed: the economy has become very large relative to the ecosystem, making natural capital the limiting factor. With large, technologically advanced fleets fishing from depleted stocks, for example, the number of fish in the sea determines how many fish can be taken.[15] (True; see Part I above.)

An important concept in ecological economics is optimal scale, which is closely related to limits to growth. Just as individual firms have an optimal scale, so does the economy. Economics teaches that the firm's optimal scale of operations is that at which marginal revenue equals marginal cost--the addition to the firm's revenue from the last unit of output produced and sold equals the addition to cost. If the firm operates at a larger than optimal scale, marginal cost will exceed marginal revenue, making profit smaller. Analogously, the economy's optimal scale is the output level at which the marginal gain from growth (additional utility from increasing the manmade capital stock) equals the marginal cost of growth (lost services from natural capital, pollution, resource depletion, environmental degradation, and so on). Beyond this point, growth generates more costs than benefits. [16]

Unfortunately, Daly maintains, the world economy has already exceeded optimal size. It is now so large that it is overloading the ecosystem's ability to serve as a source and a sink.[17]

III. The Steady-State Economy

Daly advocated an economy which, unlike the growth economy, is sustainable--i.e., can continue for an indefinitely long period (though not forever)--in a finite world. Specifically, a steady-state economy (SSE), in which the stock of manmade capital and the population are fixed, and the throughput supporting them is minimized. Since natural capital is now the scarce input, we should maximize its productivity: get as much utility from it as possible while minimizing its use. Economic growth (quantitative enlargement) is forsaken in favor of development (qualitative improvement).[18]

Stabilizing population below carrying capacity is crucial. Population should be stabilized, moreover, at a level which allows enough per capita wealth for a good life. Daly's working notion of a good life is Malthus's standard that it would enable one to have a glass of wine and piece of meat at dinner. A decent standard of living, he maintains, would "rule out populations at or above today's level. What really must be stabilized is total consumption, which of course is population times per capita consumption. Both of the latter factors must be reduced."[19]

A sustainable economy requires that throughput should be "within the regenerative and absorptive capacities of the ecosystem." Renewable resources should not be taken faster than the ecosystem can replace them. Nonrenewable resources should be taken no faster than renewable substitutes can be developed. Waste and pollution quantities should not exceed a sustainable level of absorption.[20]

Acknowledging the value of liberty, the difficulty and undesirability of micromanagement, and the market's effectiveness at resource allocation, Daly maintains that attaining and maintaining a steady-state economy should rely as much as possible on macro-level social controls and preserve the maximum possible individual freedom. One reason for keeping the load on the environment well below carrying capacity is that the greater the strain on the ecosystem, the greater the need for intrusive micromanagement.[21]

Our first task, Daly persuasively argues, is to stop growth. Only after we have stabilized the economy at or near its present size should we determine, and move to, an optimum scale. For one thing, since our survival depends on stopping growth, it is imperative that we do so as soon as possible. Besides, settling such issues as the optimal levels of population and per capita resource use will be difficult, as it will entail searching public debate over such fundamental questions as the present generation's obligations to posterity and reproductive freedom. Achieving consensus on them will be time-consuming. Meanwhile the economy would still be growing and further damaging the ecosystem. Also, making the economy smaller can't be done without halting growth first. Lastly, before optimizing, it would be useful to gain experience and know-how in setting up and running an SSE.[22]

While excellent resource allocators, markets have their limits. As Daly observed, and as Part I confirms, "The market cannot, by itself, keep aggregate throughput below ecological limits, conserve resources for future generations . . . or prevent overpopulation." It cannot, then, answer the all-important question of how big the economy should be relative to the environment.[23]

Accordingly, the steady-state economy would supplement the market with three institutional arrangements to reduce our burden on the environment to what it can bear long-term:

(1) Maximum and minimum limits on personal income, and a ceiling on personal wealth. If growing inequality in income and wealth is not reversed, Daly argues, private property and markets will become morally dubious. This will make extending the market to include birth licenses and depletion quotas politically difficult. Moreover, curbing these inequalities would make for more modest, and environmentally supportable, consumption. Daly is committed to social justice as well as sustainability, and income and wealth limits obviously serve that goal.[24]

Since Daly made this proposal, income and wealth inequalities have exploded. Many large incomes were acquired by gaming the system, e.g., corporation executives paying themselves opulently. This threatens to delegitimize our economic system. What's more, such rapacity sets the wrong kind of example in a limited world.

(2) Transferable birth licenses. Obviously, population growth is a major force driving resource depletion and waste generation. Stabilizing population is therefore crucial. Daly's suggestion, first propounded by economist Kenneth Boulding in 1964, is to issue each person, or perhaps each woman, a quantity of reproduction licenses equal to the replacement fertility rate of 2.1 births per woman. Each woman would get 2.1 licenses, which she could buy or sell depending on how many children she wants to have.[25]

Daly acknowledged that the directness of the birth license plan might put people off. "It frankly recognizes that reproduction must henceforth be considered a scarce right and logically faces the issue of how best to distribute that right and whether and how to permit voluntary reallocation." Because limiting reproduction is a forbidden subject for many people, they prefer indirect discouragement of reproduction through expanding women's social roles, encouraging consumption of commodities over having more children, and so on. Birth licenses, however, are more efficient. What's more, in his view, "the direct approach requires clarity of purpose and frank objectives, which are politically inconvenient when commitment to the objective is halfhearted to begin with."[26]

(3) Depletion quotas for resources. The best way to control throughput, Daly argues, is to control the rate at which resources, especially nonrenewables such as fossil fuels, are depleted. Limiting the quantity of resources that enters the economy necessarily also limits how much waste and pollution leaves it. Moreover, since the stock of manmade capital is made from resources, and since the human population depends on resources, controlling the rate of depletion necessarily controls how big the population and capital stock can get.[27]

Taxing resource depletion is one way to limit it. Setting depletion quotas is better, Daly persuasively argues, because it imposes a direct, quantitative control on the throughput level, whereas the impact of taxes is less certain, depending on how demand responds to the augmentation of prices by taxes. The depletion quota scheme would entail auctioning quotas to resource purchasers, who would then buy the resources they need. The total price the resource user pays would be raised, since he would have to first buy the quota and then buy the resource. Resource buyers would have to be more efficient and thrifty in using resources. So would the consumers of their products, which would be more expensive due to higher input costs. Although he prefers quotas, Daly acknowledges that taxes would be easier to administer, and might be politically easier to implement.[28]

The merits of Daly's idea are obvious. More expensive resources would encourage consumers to demand, and manufacturers to produce, goods which are durable and repairable, improving product quality. The outflow of trash would decline. Higher resource prices would also encourage recycling.

These institutions would set parameters determining the overall level of economic activity and the aggregate human impact on the ecosystem. Within those limits, markets would be free to function. Daly's aim in structuring the SSE this way is to minimize demands on the environment while keeping government micromanagement of people's economic activity minimal.[29]

Rightly disliking world government, Daly contends that rather than creating a single global SSE, humanity should create national SSEs, reflecting each nation's values. Some might prefer few people and affluent lifestyles, others more people and less affluence.[30]

Adopting the SSE institutions alone is not enough to save us. Daly points out that national defense and other priorities could be invoked to keep raising the depletion quotas, that industries with a stake in population growth could get Congress to provide birth licenses above replacement level, and that the wealthy could agitate for higher income and wealth ceilings. "Nothing will work unless we break our idolatrous commitment to material growth." A worthwhile steady-state economy "absolutely requires moral growth." Changes in both institutions and values are necessary, and changing the latter is more important.[31] The steady-state economy is not a magic solution which will enable us to evade difficult changes in our values.

IV. The Need is Urgent

Daly's SSE is desperately needed. As penetrating observers have long warned, our situation is dangerous and becoming more so.

In 1949 Hubbert pointed out that because fossil fuels are finite, their extraction and use would necessarily be temporary, and therefore modern conditions are "precarious" and "among the most abnormal and anomalous in the history of the world." Decades later he warned that the finitude of fossil fuels and metal ores makes sustained, exponential population and output growth impossible, and therefore growth would prove "transient and ephemeral."[32]

Similarly, William Catton observed that adoption of fossil fuels brought a momentous change: man was no longer operating on energy currently obtained from the sun, but was now dependent on finite and nonrenewable energy sources. This greatly augmented carrying capacity, making great population growth possible, but since this augmentation rested on capital consumption, it was chimerical, "phantom carrying capacity," fated to be temporary. Population thereby overshot carrying capacity. Worse, this development inflicted habitat damage and thereby *reduced* carrying capacity. Once the fossil fuels were depleted, however, "the human niches based on burning that legacy would collapse, just as detritovore niches collapse when the detritus is exhausted." The human population bloom would likely be followed by a die-off.[33]

To quantify our overshoot of the ecosystem's regenerative capacity, Mathis Wackernagel and other scientists measured the flows of resources and wastes into the biologically productive area needed to maintain these levels of resource extraction and waste absorption. Addressing six activities--growing crops; grazing animals; harvesting timber; fishing; creating infrastructure for housing and so on; and burning fossil fuels--Wackernagel et al. determined that human activity took 70 percent of Earth's regenerative capacity as early as 1961, and 120 percent by 1999. That is, we had overshot by 20 percent. And this approach omits activities "that systematically erode nature's capacity to regenerate"--i.e., lower carrying capacity--and therefore understates overshoot.[34]

We depend profoundly on fossil fuels for food. Hydrocarbons provide fuel for farm machinery, transport, and pumping groundwater; natural gas for fertilizer production; and energy throughout the process from harvests to food on the table. As physicist Albert Bartlett observed, "Modern agriculture is the use of land to turn petroleum into food." Long true of developed countries, this is now true of much of the developing world too. The Green Revolution succeeded largely through lavish use of fossil fuels, and greatly increased the energy-intensiveness of Third World agriculture.[35] Obviously, the growing post-peak scarcity of oil and gas will leave us unable to feed ourselves.

Meanwhile population is growing at 1.2 percent a year, for an annual net gain of 77 million people. Even assuming declining fertility thanks to family planning, the United Nations projects that world population will reach 8.9 billion in 2050, 2.6 billion above today's 6.3 billion. If current fertility levels persist, population will more than double, to 12.8 billion.[36] Moreover, all governments and societies still pursue faster economic growth.

We are going ever farther out on a limb which resource depletion will saw off. The myopic strategy of natural capital consumption has created what Lester Brown aptly calls "an environmental bubble economy."[37]

As Henry Kendall and David Pimentel noted, only a limited amount of land is suitable for raising food, and most of it is already in use.[38] A growing population will devour ever more land for housing, roads, etc., at the expense of forests (and their ecosystem services) and agricultural land. The ecosystem will have to work harder with less land to feed more people.

Achieving this is unlikely. Even in advance of the oil peak, we are apparently already hitting a ceiling on food production. Fertilizer application has hit diminishing marginal returns. Plants' natural ceiling on their capacity for absorbing nutrients has been reached in many places. In the U.S. and Western Europe, fertilizer use has stopped growing. Growth in grain yield per hectare is slowing. World grain production peaked in 1997 at 1,879 million tons. In 2000-2003, grain harvests fell short of consumption every year, the shortfall rising from 16 million tons in 2000 to 105 million tons in 2003. Grain stocks fell from 112 days' consumption at the end of 1998 to just 59 at end-2003, a decline of almost 48 percent.[39]

The longer we stay on our present path, the worse our prospects. Consider the equations:

$R = r \times P$ $W = w \times P$

where R is aggregate resource use, r is per capita resource use, W is aggregate waste generation, w is per capita waste generation, and P is population.

The longer we pursue affluence, and the longer population grows, the more we will deplete resources and overload the environment with wastes. Sources and sinks available for the future diminish accordingly, so the sustainable future living standard and population must drop too. The longer we keep overshooting carrying capacity, the more we lower it--the more we mortgage the future.

The more we grow now, then, the more we must shrink later to arrive at a sustainable economy and population. Thus even as our present course makes conversion to an SSE ever more *necessary*, it also makes it ever more *difficult*; a hideous predicament.

Another implication is that if a sustainable R and W must be *substantially* below present levels, this cannot be achieved entirely by reducing living standards. A smaller population is necessary.

Daly recently said that the SSE we can now achieve will be "inferior to the one we could have had if we had started earlier," and require lower population and living standards than we have now.[40]

Years ago he warned that growth in a finite world "is eventually bound to result in both a food crisis and an energy crisis and in increasingly severe problems of depletion and pollution."[41] He was right. With oil peak imminent we will likely experience all of these simultaneously and soon, as the "environmental bubble economy" pops. It is imperative that we face our situation and promptly begin shifting to a steady-state economy.

V. What Can Be Done?

Daly's SSE institutions are sensible, but attaining them will be difficult due to opposition from powerful entrenched interests and pressure groups. Much education and persuasion, of both the public and the leadership elites, will be necessary. Meanwhile, we must move promptly to reduce pressure on the ecosystem and shift to a steady-state economy, using available means. Specifically:

Quickly phase in substantial taxes on fossil fuels, especially gasoline. Annual per capita oil use is 26.4 barrels in the United States and Canada, versus 12.2 barrels in the oil-producing countries of western Europe. Yet European living standards are not much below ours. Fossil fuel taxes would flush the wastefulness out of America's oil use. As Daly aptly observes, "a truth-telling price for energy would straighten out our transportation system better than anything else and [I] would concentrate efforts on that."[42]

Abolish subsidies encouraging fossil fuel use. As Brown argues, they not only accelerate nonrenewable resource depletion, but in effect subsidize climate change.[43]

Price water to reflect scarcity and encourage conservation.

Halt immigration. This is crucial. Open immigration, Daly notes, "will undercut any national policies of self-discipline and restraint in consumption and population growth."[44] Immigration is now the main driver of Western population growth, through immigrants' arrival and their subsequent reproduction. Indigenous fertility in European nations is below replacement. After 1965, American fertility also fell below replacement, meaning that without immigration, America would experience slow population decline. According to the Center for Immigration Studies, in recent years, America admitted over 1,500,000 immigrants annually, and immigrants have some 750,000 children annually, so immigration augments America's population by over two million persons a year, generating at least two-thirds of our population growth.[45]

Given this, the most effective measure Western nations can take to stabilize their populations, and move toward an SSE, is to stop immigration. Since immigration control has much public support, it is politically attractive. It would certainly be an easier sell than birth licenses. Ecological gains would be substantial. If immigration is the main driver of Western population growth it must follow that it is perhaps *the* major contributor to our growing resource use and waste generation, and that halting immigration would greatly ease pressure on Western ecosystems. It would also reduce stress on the *global* ecosystem. Per capita resource use and waste generation are far higher in the West than in the less developed countries sending virtually all immigrants. An immigrant who adopts even a modest Western lifestyle stresses the environment far more than he would in his homeland. So mass immigration, shifting millions of people to nations with higher per capita "ecological footprints," substantially increases world resource use and waste generation. The longer and more complete the immigration ban, the better.

Eliminate subsidies to industrial agriculture. Mechanized, fossil fuel-dependent, and neglectful of soil conservation, our agriculture is unsustainable. Subsidies encourage agroindustrial corporations' profligacy; removing them will retard it.

Abandon globalization. As Daly points out, globalization, by encouraging consumption of cheap imports and pressuring domestic producers to cut costs, makes it harder to set prices so as to reflect ecological costs. Tariffs are necessary to protect domestic goods priced to internalize costs from being undersold by imports.[46]

We must also revise our values and our attitude towards existence. Living within the limits imposed by existence on a finite planet governed by physical laws requires great self-control in actions having physical consequences. As Arnold Toynbee observed, "Nature is going to compel posterity to revert to a stable state on the material plane and to turn to the realm of the spirit for satisfying man's hunger for infinity."[47]

Notes

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11. Daly, *Steady-State Economics*, pp. 8, 16, 24-25.
12. Ibid., p. 9; Herman E. Daly, Beyond Growth: *The Economics of Sustainable Development* (Boston: Beacon Press, 1996), p. 67.
13. Daly, *Beyond Growth*, pp. 104-106.
14. Ibid., pp. 76-77.
15. Ibid., p. 78.
16. Daly, *Steady-State Economics*, pp. 27-29; Daly, "Uneconomic Growth in a Full World," pp. 172-173.
17. John Attarian, "A Conversation with Herman Daly," *The Social Contract*, vol. 13, no. 3 (Spring 2003), p. 155.
18. Daly, *Steady-State Economics*, pp. 16-18.
19. Daly, *Beyond Growth*, p. 14.
20. Daly, *Beyond Growth*, p. 28; Daly, *Steady-State Economics*, p. 256.
21. Daly, *Steady-State Economics*, pp. 51, 89.
22. Ibid., pp. 51-53.
23. Ibid., p. 89.
24. Ibid., pp. 53-56.
25. Ibid., pp. 56-58.
26. Ibid., pp. 59-60.
27. Ibid., p. 61.
28. Ibid., pp. 62-68, 191-192; Attarian, "A Conversation with Herman Daly," p. 156.
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41. Daly, *Steady-State Economics*, p. 12.

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John Attarian, Ph.D., now deceased, was a freelance writer and independent scholar from Ann Arbor, Michigan. He authored several books including *Economism and the National Prospect* (2001), and *Immigration: Wrong Answer for Social Security* (2003). Dr. Attarian died near his home on December 31, 2004.

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