

Chapter 1

Ecological Economics

During the question-and-answer time I asked the chief economist [of the World Bank] if . . . he felt that the question of the size of the economic subsystem relative to the total ecosystem was an important one, and whether he thought economists should be asking the question, what is the optimal scale of the macro economy relative to the environment? His reply was immediate and definite: “That’s not the right way to look at it.”

—Herman E. Daly, *Beyond Growth*

Until the 1970s, ecologism had no systematic economic theory to accompany its conservation ethics and its critique of the social and aesthetic shortcomings of the mainstream culture. In his *Sand County Almanac*, Aldo Leopold had stated that the “most serious obstacle impeding the evolution of a land ethics is the fact that our . . . economic system is headed away from, rather than toward, an intense consciousness of land.”¹ He urged that the proper use of the land be judged in terms of what was ethically and aesthetically right, rather than in terms of economic expediency. Thus, his classic formulation: “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it does otherwise.”² But Leopold, who was trained as a forester and worked for the United States Forest Ser-

vice, never developed a comprehensive critique of the prevailing economic system which is a “most serious obstacle” to the attainment of the principal goals of contemporary ecologism. The economic implications of ecologism were probably left unarticulated not only because the foremost environmentalists were not economists, but also because a full articulation of these implications necessarily led to a confrontation with the principles and practices of industrial capitalism. Since one obvious alternative to capitalism was socialism (with its perceived association with the Soviet Union), it is understandable why an ecological economic critique of industrial capitalism remained undeveloped for so long.

Reconnecting Economics with the Physical World

In 1977, *Steady-State Economics* by Herman E. Daly was published.³ Daly, a student of Nicholas Georgescu-Roegen, author of *The Entropy Law and the Economic Process*,⁴ reconnected economics with the physical world and its processes. In *Steady-State Economics* and subsequent writings, Daly rejected an economic theory that abstracted economic practice from its real energy and material sources and he reintroduced a concept not unfamiliar to classical economists such as Adam Smith, Thomas Robert Malthus, and David Ricardo but utterly marginalized in neoclassical or mainstream economics—the concept of limits.⁵ Daly held economic theory and practice accountable to the second law of thermodynamics (the entropy law) which states that in closed systems, that is, systems receiving no new inputs of energy and matter, useful or low entropy energy and matter are transformed over time into high entropy energy and matter or waste. Translating the entropy law into economic terms, all economic activity necessarily converts potentially useful energy and matter into commodities of one kind or another, commodities which over time are used up or deteriorate and become waste to be disposed of. Thus, all economic commodities represent a kind of halfway house located between the process of extraction and transformation of low entropy resources into commodities and the removal of garbage or high entropy wastes. Since the Earth is not physically growing and receives only solar energy inputs at a rate which cannot be altered, the notion of unlimited economic growth, that is, unlimited inputs of energy and matter into economic production and unlimited outputs of waste into the environment, cannot be seriously upheld. What has given a specious plausibility to the notion of ever-increasing economic growth has been the extravagant use of limited stocks of terrestrial nonrenewable energy sources—fossil fuels. Unlike solar energy which is stock-abundant but flow⁶ limited, fossil fuels are stock-limited but flow abundant, since flow from these stocks is determined by human choice and policies although the stocks themselves are nonrenewable. For example, a decision to build more

highways and manufacture more automobiles is a decision to use more of the nonrenewable energy stocks such as oil. Since all industry and large-scale agriculture depend on such stock-limited energy sources, it is not difficult to understand why once economic theory and practice are viewed from the perspective of the entropy law, the notion of unlimited economic growth makes no good sense.

If the notion of unlimited economic growth makes no good sense given a planet which is not growing materially, whose only source of unlimited (given estimates of the sun's lifespan) energy is flow-limited and whose terrestrial energy sources are limited and, in the case of fossil fuels, nonrenewable, why then does this notion persist among mainstream economists, government officials, and the general public? In the case of the economics profession one can argue that the nature of the discipline lends itself to the abstraction of theory and practice from its physical and social base in the real world. Standard economics textbooks describe the economic system as a circular flow of national product and income regulated by a perfectly competitive market, driven by individuals maximizing utility (satisfaction) and profit. The schemas that illustrate this economic model give no indication at all of the biophysical basis of all economic activity. Despite accumulating evidence that a healthy⁷ economy is not possible in a deteriorating environment, the majority of economists and most economic courses taught still conceptualize economics through the mainstream paradigm which simply cannot accommodate the notion of economic dependency on biophysical factors. The environment in this conventional paradigm remains an "externality," something irrelevant to economic theory and practice. When the second edition of Daly's *Steady-State Economics* appeared in 1991, the author commented that in the years between the first and the second printing "not one economics journal bothered to have *Steady-State Economics* reviewed."⁸ Clearly, what cannot be conceptualized within the mainstream economic paradigm goes unnoticed. If the Dow goes up fifty points that is a sign of economic progress. What impact on the environment this fifty point rise has is a question that would puzzle the Wall Street analysts who otherwise speak so knowingly about the intricacies of the stock market. To suggest that the health of the economy is not accurately measured by GNP (Gross National Product), GDP (Gross Domestic Product), Dow, S and P (Standard and Poor), and Nasdaq indices is to bring into question the chief mainstream economic dogma—that unlimited growth is the sine qua non of progressive societies.

Government Promotion of Unlimited Growth

Unlimited economic growth is espoused by government, regardless of the party controlling the branches of government, for several reasons, an obvious one being that the economists who advise government officials all urge economic

growth provided such growth does not create unacceptable inflationary pressures. Short-term political interests also dictate that the party in office (and individual office holders regardless of party) encourage economic growth in order to provide employment for the millions of young adults who enter the workplace each year. Since most individuals possess neither land nor capital with which to provide income, jobs have to be created by those who have these assets and it becomes the task of government to support by tax policy, trade agreements, government contracts, subsidies, and infrastructure construction (including schools) the activities of the private sector. Those who argue that the government hinders a free and competitive market overlook the fact that government policy in the main provides encouragement to economic expansion even beyond national borders. This encouragement of economic expansion is dictated not only by the political fallout of economic downturns, but also by campaign contributions from corporate sectors to parties and candidates. Environmental regulations imposed on businesses are not really an exception to the policy of encouraging economic expansion. With some exceptions the major task of the EPA (Environmental Protection Agency) is to regulate end-of-pipe emissions and set emission standards for a limited variety of substances, none of which has a palpable effect on economic production and economic expansion. Moreover, enforcement mechanisms for the existing environmental regulations are hardly draconian,⁹ necessary monitoring staff is often not available, fines can be negotiated, and proving a violation in court is a lengthy and costly process. The fact that many if not most metropolitan areas remain out of compliance with EPA-mandated air quality standards, for example, years after the standards were mandated and deadlines set, indicates that the economic activities that cause air pollution (including the manufacture of automobiles, a major source of urban air pollution) are in no danger of being constrained to the point where economic expansion is threatened. Given the present dependence of the industrial production system on fossil-fuel energy, the same energy source which causes much of the pollution problems, it is to be expected that in the present situation economic expansion interests will normally trump stringent and effectively enforced pollution regulations.

The focus on economic growth also avoids serious discussions of policy dealing with distribution of income. It is argued that a rising tide lifts all boats and that economic growth benefits all classes. The argument is staunchly maintained despite data showing an increasingly skewed income distribution pattern in the United States with the top 5 percent of income earners benefiting disproportionately from economic growth while the income of the bottom quintile has decreased in the last twenty years. Data also show that the median income in the United States has stagnated for the last two decades if not actually declined. Economic growth, contrary to standard claims, does not provide significant benefits to all classes; in fact, economic growth given

existing tax policies, trade agreements, and subsidies selects for specific groups which occupy strategic positions in the economy.¹⁰

Advocates of unlimited economic growth also argue that only an expanding economy can provide the surplus funds needed to pay for environmental programs designed to address pollution and other forms of environmental damage. It is said that only more economic growth can correct the environmental damage caused by economic growth. Assuming even that surplus funds generated by economic growth will be directed to environmental protection (a questionable assumption given the customary political maneuvering to capture anticipated federal surpluses), there is no guarantee that the damage done to the environment and to specific ecosystems is reversible. For example, species rendered extinct are not recoverable and eroded soil cannot be retrieved. At this point, the call for unlimited economic growth becomes a mantra uttered whenever various problems appear: unemployment, trade imbalances, crime, decaying urban areas, infrastructure deterioration, environmental damage, destabilization of families, and national security. A more critical analysis of the consequences of policies aimed at unlimited economic growth reveals, instead, that many of the problems which economic growth is supposed to eliminate or ameliorate are directly or indirectly the products of a dogmatic commitment to increase both the inputs of energy and matter and the outputs of the production process with no limits in sight.

The Culture of Unlimited Growth

Thus far, the argument for unlimited economic growth has been connected to the interests of government and economic elites. Given the relatively short-term interests that characterize the activities of elected officials and the discounting¹¹ of the future by the economic sector, it is understandable why promoting unlimited economic growth is not an irrational policy for these groups to follow. But the public is also attracted to a policy of unlimited economic growth, if for different reasons. There is, first, a fascination (induced by urbanization, industrialization, media advertising, and the pervasive enculturation of consumer values) with the products and services of the growth economy. The symbiotic relationship of scientific research, technology and the production process has resulted in an unending stream of electronic products entering the market; the globalization of trade brings a variety of exotic foods and cheap goods;¹² and credit makes it possible for millions to participate in the market. Increasingly, for many the acquisition of consumer goods and services defines the good life as more and more formerly private forms of production, recreation, and social interaction are transformed into commercial market activities. For most, the workplace offers few opportunities for

personal initiative or creative endeavors and the products or services produced and the production processes are outside the control of workers. The purchase of consumer goods and services, therefore, represents the psychic compensation for the hours of work required at the job. “Thank God it’s Friday” and “I owe it to myself” are commentaries on both the level of job satisfaction and the justification of self-indulgence as a reward for enduring the job experience. The denaturing of the urban and suburban environment where most industries and businesses are located also contributes to the consumer life-style. The loss of natural amenities such as open space, diverse landscapes, and contact with varied fauna and flora creates an experiential vacuum which is filled, however temporarily and unsatisfactorily, with consumer goods. That today’s commodity is replaced by tomorrow’s in a sequence for which there is no clear terminal point other than old age and death, would indicate that the consumer behavior involved is obsessive and seeks to fill a need that cannot be satisfied with material goods.

The existing economic system thus operates like a treadmill in that as economic growth accelerates, everything connected with it accelerates without a final goal being reached.¹³ Energy and material inputs increase; production outputs of goods and waste increase; consumption of goods and services increases; environmental damage increases; income distribution is further skewed to one end; more jobs are created (if not always in the United States than in other countries, usually developing ones where wages are low). Then more tax revenues are needed to provide social services for the growing population of the poor and aging and to address environmental damage caused by economic growth and social problems such as crime, violence, addiction, all of which are connected to the dominant unlimited growth system. And these revenues can only be produced, under existing political policies, by an expanding economy and so the treadmill again accelerates. However successful the treadmill system is in the short or intermediate term, it operates at the expense of the natural environment, the biosphere, which sustains all life. Like autophagia the system feeds on its own tissues.

Challenging the Dominant Economic Paradigm

Looked at from a critical distance, outside of the mainstream perspective, the prevailing economic system with its assumption of unlimited economic growth appears irrational at the very least. Its major premises and practices run counter to physical laws of matter and energy; its activities undermine the physical basis of life; and its promise of providing the good life can be met only if the good life is defined as the maximum accumulation of material goods, although what “maximum” means when no limits to accumu-

lation are suggested is unclear. Yet, the system has enormous staying power. In the past two hundred years it has managed to place at the disposal of average citizens in developed nations goods and services that even a pharaoh might envy. Its assumptions about economic growth and progress have permeated all existing cultures and, as mentioned, it serves the interests of political and economic elites everywhere. It has been so successful that it illustrates what Robert L. Heilbroner refers to as the “law of the retarding lead,”¹⁴ in that its very success retards efforts to change it even when it is on an unsustainable course.

Despite its enormous inertial force, the existing economic system is creating so many environmental and social perturbations that its emphasis on more growth is being met with increasing skepticism and in the last three decades or so an alternative to the current growth economy has been developed. Called “ecological economics” this alternative has as its core postulate the notion that the Earth has limited capacity for sustainably supporting people and their artifacts over the long run and that this capacity is determined by the interaction of resource limits¹⁵ and ecological service thresholds.¹⁶ What follows is an explication of the fundamental premises and policy recommendations of ecological economies.

Because the dominant economic system is largely immune to substantive criticism, most people in developed countries understand by the term economics such things as stock market reports, unemployment figures, inflation percentages, GNP numbers, corporate earnings reports, median incomes, and so on. But these various economic indices serve to obscure economic activity as human interaction with the biophysical world that supplies the energy and matter that makes economic activity and all life possible. In this most fundamental sense, economics represents the human extraction from the environment of useful (low-entropy) energy and matter which is transformed by historically changing patterns of production into usable goods and services which over time are returned to the environment as waste (high entropy), discarded when considered no longer useful. How the goods and services are distributed depends historically on political decisions which in turn depend on existing power structures. In contemporary market capitalist societies such distribution occurs through market exchanges (goods for money and wages for work) which operate in the context of private ownership of capital with the great majority of individuals working for private employers. Since humans cannot exist without extracting resources and converting them into goods and services, there can be no substitute for economic activity. What is in question here is whether the way the current economic system operates in terms of extraction, production, distribution, and disposal of waste can be continued over the long run without causing irreversible damage to the environment and thus destroying the basis for its existence and the existence of human and nonhuman life.

Economic growth from a thermodynamic perspective represents higher outputs of goods and services which in turn require higher inputs of low-entropy energy and matter, all of which produces more waste and more damage to the natural environment which provides such essential services as photosynthesis, atmospheric gas regulation, pest control, and pollination. Claims that more economic growth nationally and globally is needed to address issues of social instability, economic inequality, and environmental deterioration are credible only if it is assumed that for the foreseeable future there is no danger of overstressing environmental limits or that capital can be indefinitely substituted for natural resources, or that technology will somehow evade the energy and resource constraints that presently exist. If, as ecological economics postulates, the economy is an open (in the sense that it receives inputs of energy and matter) subsystem of the biophysical environment (which is semiopen in that it receives a solar flow of energy but no material inputs) and is utterly dependent on the latter both as a source of low-entropy energy and as a sink for high-entropy wastes, then the argument for an ever-accelerating economic growth is not credible and the problems such growth claims to address will only be further aggravated by increasing levels of throughput. Social instability in the United States in terms of crime, violence, divorce, family disintegration, and addiction has risen in past decades and continued economic growth has not prevented habitat loss, suburban sprawl, soil erosion, air and water pollution, and increased use of nonrenewable fossil fuels. Continued economic growth therefore begins to appear as a cure worse than the disease it claims to remedy.

The Complementarity of Natural and Man-Made Capital

The conventional argument for continued economic growth made more sense when the economy operated in an empty world scenario, when the scale of the economy was small compared to the planetary environment as yet unaffected by economic activity. In a full world scenario, when the scale of the economy is such that it affects almost the entire planetary environment, unending economic growth combined with exponentially increasing human populations creates patterns of production and consumption which are not sustainable over the long run. The 1987 Brundtland Report, *Our Common Future*, sponsored by the United Nations, defined sustainable development (not growth)¹⁷ as development which meets the needs of the present without undermining the ability of future generations to meet their needs. Daly has refined this definition and made it especially applicable to the developed

nations of the North: “. . . [A] level of resource use that is both sufficient for a good life for its population and within the carrying capacity of the environment if generalized to the whole world.”¹⁸ Thus, sustainable development is defined as population and production levels that do not breach the capacity of the environment to provide renewable resources and absorb wastes. A sustainable economic system is one that stops physically growing once environmental limits have been reached. At this point, as Daly states, production of goods and reproduction of humans is for replacement only. Physical growth ceases while qualitative improvement continues in the use of a given scale of throughput, for example, achieving greater natural resource productivity, utilizing “wastes” as resources elsewhere in the production cycle, reducing energy inputs through greater energy efficiency and conservation, producing more durable and repairable goods, recycling materials, regenerating and maintaining natural capital, and providing local, regional, and national land use policies that not only prevent wasteful use of natural resources and spaces, but also reduce the present transportation costs reflected in inefficient energy use, air pollution, accidents, and traffic jams.

The existing economic system is like a spendthrift, living off its capital, natural capital,¹⁹ rather than off its interest, the services provided by a natural capital which is either renewable or nonrenewable and naturally occurring or cultivated. Capital, be it natural or man-made, is defined as stock which produces a flow of valuable goods or services. Renewable natural capital or stock can be maintained indefinitely but its flow of goods and services is limited by biological reproduction rates. Trees are renewable and provide goods and services as long as such stock exists but they cannot be cut down faster than their natural reproductive patterns. Nonrenewable natural stock is obviously a limited stock and the volume of its flow of goods and services is determined by economic demand and to some extent by government policy which allows access to nonrenewable natural capital on public lands. Neoclassical or mainstream economics still maintains the concept of the infinite substitutability of man-made capital for natural capital and entertains the notion of increasing production accompanied by a reduced stream of natural capital or resources.²⁰ Ecological economics, on the other hand, maintains that man-made capital and natural capital as factors of production are not substitutable for one another but must be seen as complementary. “The complementary nature of natural and man-made capital is made obvious by asking: what good is a sawmill without a forest? A refinery without petroleum deposits? A fishing boat without populations of fish?”²¹ Thus, the limiting factor of production when using renewable resources is not the number of fishing boats but the reproductive rates of fish; not the number of sawmills but the remaining forests. One kind of natural capital can be substituted for another and man-made capital can reduce the amount of natural capital used in production either by more

efficient use of natural capital or by changing the mix of natural and man-made capital in production. But man-made capital cannot be a substitute for natural capital. Machines are made of natural capital and can no more replace natural capital than a hammer can replace iron ore. If natural capital is the limiting factor of production in a full world scenario, it makes no sense economically to use up the scarcest resource first.

In a sustainable economy, renewable resources would not be harvested beyond their reproductive capacity, wastes exported into the environment would not exceed the assimilative capacity of the environment and the depletion of nonrenewable natural capital would be offset by investments in renewable natural capital, for example, fossil fuels replaced by solar and wind energy. An economy based on sustainable development would understand income as defined by J. R. Hicks:²² the amount that could be spent by an individual in a period of, say, one week without jeopardizing one's well-being at the end of that time. No economy can be better off if its income is derived from the liquidation of natural capital any more than it can be better off from the liquidation of man-made capital. Individuals who draw their income from their savings rather than the interest from the savings are not better off when the savings are spent. National economies that count as income the liquidation of natural capital cannot be better off when the natural capital is exhausted. The individual or business or nation whose income depends on interest from man-made capital investment assumes that the depletion of natural capital can be more than matched by the increase of man-made capital, for example, $5NK+5MMK=1NK+9MMK$ ²³ or what is defined as weak sustainability. For ecological economics, strong sustainability or the increase of natural capital along with a constant or increasing man-made capital is essential. The Hicksian definition of income applies, therefore, to income based on strong sustainability with renewable natural capital utilized in such a way as not to destroy its reproductive base and with some of the income from nonrenewable natural capital used to invest in renewable natural capital substitutes (El Serafy's rule).²⁴ Weakly sustainable income is possible in the developed world only if some nations and regions export their natural capital to the developed centers. Some nations can escape the constraints imposed by the carrying capacity of their environment and its natural capital only if other nations stay below the carrying capacity of their environment so as to be able to export their natural capital. "In other words, the apparent escape from scale constraints enjoyed by some countries via trade depends on other countries' willingness and ability to adopt the very discipline of limiting scale that the importing country is seeking to avoid."²⁵ The unsustainability of an economy which liquidates its natural capital is thus hidden, in the short run, by importation of natural capital from other regions and by the liquidation of domestic natural capital stocks when the flow of resources from the existing natural

capital stock is no longer sufficient to serve the input needs of accumulating man-made capital. This unsustainability is also hidden to some extent by cultivating natural capital, for example, by developing plantation forests and providing a constant flow of timber. But plantation forests are developed to provide wood, not habitats for a diverse plant and animal population. A more ethically complete definition of a sustainable economy is one, therefore, that meets the needs of the present without compromising the ability of future generations of humans and nonhumans to meet their needs. Including consideration for the well-being of future generations of nonhumans further limits the optimal scale of economic development and makes more urgent the preservation of natural capital stocks, the biological basis for all life on Earth, human and nonhuman.

Economic Man and the Fallacy of Misplaced Concreteness

Mainstream economic theory has no place for ethical judgments or more precisely it has room only for the ethics of individual self-interest at a given point in time stripped of biophysical reality. Since the point in time is the immediate present, it can be said that economic markets are the meeting places of producers and consumers separated from history, social context, and biophysical reality. Market exchanges are seen as the means by which scarce resources are efficiently allocated among alternative uses. Consumers in mainstream economic theory are individuals who prefer more goods to fewer; who prefer a mix of goods to goods of only one kind; who are interested in maximizing their own utility (satisfaction) and are willing, in principle, to trade any good for any other good (more automobiles for less clean air) in order to achieve that end. In mainstream economic theory it is assumed that if individuals are allowed to pursue their self-interests, that is, if economic transactions take place in a free market, such competition among individuals each striving to maximize self-interest will lead to the greatest social welfare. In the jargon of neoclassical economics, a free and competitive market will tend toward Pareto optimality²⁶ in consumption, a situation when no further market exchanges can make one person better off without making someone else less well off. The production theory of neoclassical economics includes conceptual elements similar to those of its consumer theory. More output is preferred to less. All outputs (as all consumer preferences) are on the same footing in that they cannot be judged as better or worse within the market framework. Resources have value only if they generate economic benefit. In production theory, a free and competitive market achieves Pareto optimality

when no further trading of inputs can increase the production of one good without decreasing the production of another good. In this neoclassical economic paradigm, the market is the decisive mechanism through which free consumers and free producers engage in exchanges which maximize their respective utilities. Through its price structure, the market permits individuals and firms to precisely determine their respective preferences and achieve the desired mix of consumption and production goods. As the economy expands, the tendency to devalue non-market transactions and decisions strengthens. To be taken seriously, issues outside of the market must be brought within the market, assigned appropriate prices and subjected to market forces.²⁷

The neoclassical economic set of assumptions about individual maximizing behavior, the assumed positive consequences for society of such behavior, and the centrality of the free market in the life of society constitute what Herman E. Daly and John B. Cobb Jr. have described as the fallacy of misplaced concreteness in economics,²⁸ the application to concrete events of the high-level abstractions of a deductive science. In its assumptions about human behavior, the neoclassical model creates an artificial *Homo economicus* or economic man whose goal is to maximize utility by engaging in market transactions to obtain goods and services that satisfy. If human existence were indeed centered on having things, *Homo economicus* would not be so much a caricature of *Homo sapiens*. But human existence involves the experience of more than possessing, of having something. Humans are not only consumers. They are family members, community members, citizens, activists, friends, lovers. They not only experience having but also creating, being, relating, doing. They seek not only economic goods and services, but also affection, understanding, friendship, participation, leisure, identity, and freedom. The goods and services the market provides are essential for meeting subsistence and security needs but all human needs cannot be collapsed into those of subsistence and material security. In the neoclassical economic paradigm consumers are assumed to be knowledgeable about the goods and services they seek in the market (indifference curves and Edgeworth Box diagrams displayed in standard economics textbooks depend for their validity on this assumption) and to be consistent in their market choices (if A is preferred to B and B is preferred to C then the consumer should prefer A to C).²⁹ But in the real world of market transactions, consumers can be quite ignorant of how commodities work and how well they will supply the service (utility) expected. Most car owners cannot repair their car engines and cannot identify the engine parts and their functions. Foods, pharmaceuticals, vitamins are ingested without any real understanding of their chemical composition and their effects on internal organs. Many items purchased have only the value ascribed by advertising which often does not correspond to the intrinsic composition of

the item. There are consumers who have expert knowledge about specific products, usually because they are professionals in their field, or because they have formal education in specific areas, or because they have made a special effort (as in the case of individuals with illnesses that require a long-term regimen of pharmaceuticals) to be knowledgeable. But the very presence of daily pervasive advertising, much of which is aimed at persuasion rather than at providing information, is evidence that the market does not depend on expert consumers to purchase goods and services but instead persuades consumers to purchase commodities that they did not know they wanted until advertising told them or purchases by others persuaded them they did. As there are clothing fashions, so there are fashions in toys, VCRs, computers, and cellular phones. Such purchases are as much in response to what are currently considered fashionable items as they are to real or perceived needs. The current popularity of SUVs cannot be attributed to changed road conditions, the disappearance of local shopping centers, significantly expanded one-time grocery shopping, better gas mileage or other circumstances that would provide a rational warrant for owning such a vehicle. Moreover, given the plethora of goods available in the market, it is increasingly beyond the competence of the typical consumer to understand the environmental and social impacts of all such commodities and as the market becomes increasingly global, the environmental and social impact of commodities produced outside of national borders is entirely outside the consumer's range of understanding. The Homo economicus view of human behavior serves to obscure the many noneconomic variables that shape human life. It also serves to obscure how the market fails to serve individual and social needs outside the narrow realm of individualized, self-interested, utility-maximizing behavior, a form of behavior which is as much manipulated as self-directed.

Understanding the Appropriate Role of the Market

The free market serves to allocate resources and commodities to producers and consumers efficiently, that is, it allocates to those firms and individuals that have effective market demand (cash or credit) those resources, goods, or services sought. The market is far more sensitive to demands of potential customers than a centralized command economy such as existed in the former Soviet Union. Ecological economics accepts the market as a necessary device to provide efficient allocation of goods and services but it recognizes the need to provide an extra-market framework within which such allocation takes place and which insures that two other goals of ecological economics are met:

fair distribution of goods and services and the maintenance of a scale of throughput that is sustainable and that does not undermine the carrying capacity of the environment.

Appropriate scale is a function of population, throughput, per capita consumption, and specific bioregional characteristics that differ geographically. The setting of appropriate scale for a modern industrial society is a contentious problem and suggests policies that will be discussed in a later section. Appropriate scale requires a concept of limits, particularly to economic growth or throughput and as such is not a relevant concern within the neoclassical economic paradigm. Similarly, the concept of an equitable distribution of goods and services stands outside the neoclassical paradigm. If sellers and buyers meet freely in the market, the resulting distribution of goods and services, as determined by the market must, by definition, be appropriate. Pareto optimality in consumption and production will be the direction in which market forces necessarily trend. The exclusion of both the notion of appropriate scale and of fair distribution from the neoclassical paradigm is another example of the fallacy of misplaced concreteness or the application of high-level abstractions to the real world of humans. Excluding appropriate scale means, as pointed out earlier, the disconnection of economic activity from operating biological and physical laws. Excluding fair distribution means ignoring the existing disparities in the ownership of land and capital and the effect of these disparities on the distribution of goods and services in the market. With each different pattern of income distribution there will be a different Pareto optimality in consumption, the point at which additional transactions cannot occur without someone being worse off.

The market allocates resources, goods, and services to those who have effective demand (unlike, for example, the Soviet economy which often did not supply goods to consumers who wanted them and could pay for them) and because those who want these and can pay for them can secure them, the market is said to allocate efficiently. "Efficient" in this context does not mean the same as the operation of an automobile that delivers twice the mileage compared to other models. "Efficient" in the market context means delivery of desired resources, goods, and services to those who want them and can pay for them. Whatever the existing distribution of income and wealth, the market will allocate efficiently as long as it is free to deliver to buyers what they want and what they can pay for. In this context, allocative efficiency does not ensure distributional efficiency in the sense that those whose needs are the greatest will have these needs satisfied. Those with the economic means can own several cars. Others without the same economic means may have to be without a car or may purchase one on credit and thus pay in the long run more than the sticker price. Since an individual cannot drive more than one car at any given time, multiple car ownership represents an inefficient use of

that particular commodity, because the natural capital consumed in the production of relatively infrequently used cars (or any other consumer durables) could have been better utilized in the production of commodities whose use value is more fully maximized. Moreover, efficient allocation in the market sense can result in the breaching of environmental limits. For example, as fish catches exceed the reproductive capacity of the fish, the market will operate to accelerate the fish catch and thus further damage the fish stock. Given an existing demand for fish and dwindling catches, fishermen will be motivated to send out more boats and use larger and heavier nets to harvest as many fish as possible as market prices for fish go up.

Following the scenario in Garrett Hardin's "Tragedy of the Commons,"³⁰ individual fishermen who attempt to reduce their catch in order to counteract the decimation of the fish stock will simply allow others to catch even more fish to supply a market willing to pay high prices. The logic of the market is not sensitive to environmental limits. The market also typically discounts the future, in that it sees the present value of a benefit as greater than its future value. If current interest rates are higher than the reproductive rates at which different forms of natural capital, for example, trees, increase, then market logic calls for selling off the natural capital, clear-cutting trees, and investing the returns at the higher interest rates offered by the market. Given the priority of the present over the future, the monetary value of a future project calculated in present terms can be quite small particularly if current interest rates are high. The discounted present value of a future project is the amount of money that would have been invested today at prevailing interest rates to generate the monetary value of a project, say, twenty years from today. A relatively small investment at 10 percent compounded over a twenty-year period can generate a substantial amount so that the present value of a future multimillion dollar benefit, for example, forest preservation, is small. Thus, the logic of the market ignores the long-term future as it ignores environmental limits. It is a logic entirely in keeping with the assumptions of the neo-classical paradigm, among these, as discussed earlier, that more goods are preferred to fewer and that consumers maximize their own utility and will trade any good for any other good to achieve that end. From an ecological economic perspective, the market serves only the needs of the present generation of buyers and sellers. The needs of future generations of humans and nonhumans are discounted and the present-oriented needs of firms and individuals with effective demand are satisfied. In an empty-world scenario market logic can prevail without severe environmental repercussions. In the full-world scenario, the world of today, market logic as it globalizes itself can be environmentally and socially disastrous.

In addition to its failure to maintain sustainable development and provide fair distribution, the market has been cited for other failures:³¹ not maintaining

competition, not enforcing ethical business practices, not providing public goods, and not internalizing externalities (failing to operate with full-cost pricing). The tendency of firms to protect themselves against competition has been countered at the state and federal levels by antitrust legislation, however variably enforced since the last decade of the nineteenth century. Unethical business practices such as fraudulent advertising, insider trading in the stock market, and sale of defective products have been countered by government regulation such as the Pure Food and Drug Act and the Securities Exchange Act. State and federal public lands, public education and interstate highways are examples of public goods provided by government and not the market. The failure of the market to internalize costs through prices represents, along with the failure to maintain competition, a major violation, even in neoclassical economics, of the conditions that enable the market to allocate goods and services efficiently. In Adam Smith's market theory, the existence of a large number of small entrepreneurs, competition, and cost internalization by each entrepreneur ensure that all market competitors will strive to lower costs, to use the factors of production as efficiently as possible so as to provide competitive prices in the market. Externalizing costs of production by draining effluents into public waters, releasing emissions into public air, dumping wastes into landfills without proper safeguards against leaking into private and public wells, surface mining without even a minimal attempt to restore the original topography, all represent a shift of the costs of production to the public whose taxes must finance any government programs aimed at air and water pollution control, remediation of toxic waste sites, and other forms of environmental regulation. Thus, cost externalization shifts costs from the producer and the individual as consumer to the individual as citizen and taxpayer. Externalized costs represent in Smithian market theory unearned profit. Environmental regulations as they operate currently inhibit but do not eliminate unearned profit at the expense of the environment (and citizens who are adversely affected by environmental degradation) just as the Fair Labor Standards Act, Wagner-Connery Act, Social Security Act, and more recently the Occupational Safety and Health Act inhibit unearned profit at the expense of wage earners.³²

The Ecological Meaning of Efficiency

While ecological economics recognizes the importance of policies aimed at cost internalization and therefore greater market efficiency in the use of the factors of production, it expands the notion of efficiency well beyond the conventional cost benefit calculations.

For ecological economics, efficiency is a measure of the ratio of the benefit from services received from man-made capital and the cost of the loss of natural capital services or

$$\frac{\text{MMK services gained}^{33}}{\text{NK services lost}}$$

where MMK is man-made capital and NK is natural capital. The ultimate benefit received from economic activity is the services provided by the stock of man-made capital. The ultimate cost of economic activity is the loss of natural capital and the ecological services it provides. Since man-made capital can only be produced from natural capital, efficiency from the ecological economic perspective requires that services from man-made capital be maximized and natural capital stock and ecological services losses be minimized. Daly represents this concept as a four-part identity

$$\frac{\text{MMK services gained}}{\text{NK services sacrificed}} = \frac{\text{MMK services gained}}{\text{MMK stock}} \times \frac{\text{MMK stock}}{\text{thruput}} \times \frac{\text{thruput}}{\text{NK stock}} \times \frac{\text{NK stock}}{\text{NK services sacrificed}}$$

The first ratio on the right represents service efficiency and requires that products are efficiently designed, that resources are allocated to different products according to market preferences, and that the stock (commodities) is distributed efficiently among individuals. The second ratio represents maintenance efficiency or durability of man-made stock and requires that the stock is repairable, recyclable and durable, thereby reducing thruput. The third ratio represents the growth efficiency of natural capital in providing inputs into thruput. The faster growing the natural capital, the more efficient its use in the sense that its biological growth rate provides more without additional inputs of fertilizer, pesticides, and similar man-made capital. The fourth ratio represents ecoservice efficiency or the minimization of losses of ecosystem services as natural stock is taken as raw material for thruput. The point of the four-part identity is to stress that the ultimate cost of all economic activity is the loss of natural stock and the ecosystem services that flow from it. The ultimate cost in thermodynamic terms is the increasing disorder in the ecosystem. If life, an open system in temporary equilibrium, exists at the cost of increasing disorder in the surrounding environment then economics, which is

the metabolic organization of human life, operates at the cost of increasing disorder in the planetary environment. A growth economy accelerates the disorder. Ecological economics aims at decelerating the disorder so that more generations of life, human, and nonhuman, can come into being, but cannot eliminate entropy.

Measuring Economic Welfare

If economic activity subject as it is to the second law of thermodynamics necessarily creates high entropy, then it is possible to speak of uneconomic growth or growth which creates more costs to the natural and social environment than benefits. Ecological economists like Daly have developed indices designed to measure the level of welfare accompanying economic growth as measured by the GNP. The ISEW³⁴ or index of sustainable economic welfare when plotted over several decades in conjunction with the GNP shows that in recent years while GNP continues to rise the ISEW has lagged behind the GNP. Since the GNP measures the domestic money flow of goods and services as well as exports, it is essentially a measure of throughput or the volume of energy and matter that is processed within the economy. All market exchanges are counted equally with money spent on housing construction or environmental remediation or HIV research or additional police or traffic accidents all added to the total GNP. To the extent that more economic growth, for example, more automobiles, creates more pollution and traffic congestion and accidents, paves over more open land, cuts through neighborhoods, requires higher automobile insurance premiums and purchases of antitheft equipment, consumes at an accelerating rate nonrenewable fossil fuels, and undermines a more energy-efficient public transportation system, to that extent more economic growth reduces welfare. Accordingly, several subtractions have to be made from the GNP in order to arrive at a more accurate measure of welfare. Since man-made capital depreciation is already subtracted from the GNP in the national accounts, subtractions are made from the net national product. The subtractions include the depreciation of natural capital, defensive expenditures such as automobile anti-theft devices (defined as intermediate costs of production rather than final consumer goods), expenditures on national advertising, costs of commuting, costs of urbanization, costs of air and water pollution, among others. Counted as contributing to welfare are non-market household services such as caring for aging parents and public expenditures on health, education, streets, and highways. An index of distributional equality measuring the degree of difference between each of the four lowest income quintiles and the highest income quintile is also in-

cluded in the ISEW. In 1950, the per capita ISEW was 2,496 and per capita GNP was 3,512; in 1990 the per capita ISEW was 3,253 and the per capita GNP was 7,755.³⁵ The conclusion drawn is that economic growth increases welfare until a threshold is reached where costs of additional growth exceed welfare benefits.

While indices such as the ISEW serve to reveal the uneconomic elements of contemporary economic growth and the increasing disparity between per capita GNP and per capita ISEW, such indices, nevertheless, do measure as contributing to welfare the largest element in the GNP, private consumption. Unless dangerous and deleterious forms of consumption are identified and subtracted from the GNP, private consumption will be included without qualification in indices such as the ISEW as a contribution to welfare, and increases in the GNP, to the extent they are tied to increases in private consumption, will always be reflected in some increase in welfare indices. Sorting out beneficial from injurious consumption requires judgment that may not be supported by empirical evidence. Just how much tobacco and alcohol consumption is acceptable before becoming deleterious to one's health? Since the purpose of economic activity is to provide goods and services to satisfy consumers' wants, welfare, on the face of it, is better served by more goods and services. Consequently, indices such as the ISEW subtract from the GNP not consumer expenditures as such but the external costs of production and distribution in an expanding economy. Traffic congestion, air and water pollution, defensive expenditures, depletion of natural capital, and the loss of ecoservices are not calculated in mainstream economics as costs to be subtracted from income. In the ISEW, these items are monetized and subtracted from the GNP as the unintended but real costs associated with the provision of goods and services for private consumption. But private consumption as such remains the major form of human welfare in the ISEW and similar welfare indices.

The Ethical and Social Limitations of an Unlimited Growth Society

Since there is no assumption of limits to economic growth in neoclassical economics, the provision of goods and services for private consumption can continue indefinitely, constantly changing the forms and characteristics of goods and services with ever more rapid cycles of change induced by technologically driven production. The nearest boundary in sight, if such can be called a boundary, is the creation of a global economy which will provide all members of the global community with a material standard of living equivalent to that presently

enjoyed by citizens of developed nations such as the United States. The rejection by ecological economics of this mainstream scenario as an “impossibility theorem”³⁶ requires that human welfare not be linked exclusively or even predominantly to the consumption of physical goods and services which require substantial inputs of energy and matter. Private consumption of goods and services represents only partial human welfare. Total human welfare involves the satisfaction of existential needs (having, being, doing, relating) and axiological or value-laden needs (subsistence, protection, affection, understanding, participation, leisure, creation, identity, freedom).³⁷

Humans have need of one another; they are as Aristotle noted, political and social animals. They seek to express themselves through the arts and literature. They are curious about the physical world which surrounds them and they develop sophisticated sciences to explain and control physical phenomena. They can find satisfaction and even pleasure in working with their hands and creating artifacts. The languages they speak are meant to be heard and responded to by other humans. The neoclassical economic view of the self-interested, utility-maximizing solipsist or *Homo economicus* who calculates which bundle of goods best serves his/her interests is a dreary reductionist abstraction from the richness and complexity of human life. When ecological economics speaks of uneconomic growth, that is, growth which subtracts rather than adds to human welfare, it is referring not only to the unsustainability of current physical throughputs needed to expand production and consumption, but also to the chilling effect such ultimately unsustainable economic growth has on the development of human emotional, intellectual, and social capacities which do not depend, in the main, on the consumption of goods and services. Given the assumption in mainstream economics that the consumption of goods and services defines the good life (or is, at the very least, the central feature of the good life), it is not surprising that the elements needed to satisfy non-consumption activities (stable communities, open spaces, participatory workplaces, education for self-enlightenment rather than for work skills required by businesses, an authentic politics of public discourse) are, intentionally or not, effectively undermined.

For ecological economics, economic activity is not an end in itself; it is a means to ends defined by individuals and society in private and public discourse. In the hierarchy of human activities and within the reality of the physical world, economics, as Daly has pointed out,³⁸ represents a set of intermediate means (labor power, physical capital created by human and natural technology). These intermediate means are dependent on the ultimate means of low-entropy energy and matter and serve or should serve such intermediate ends as health, comfort, and education which are part of the existential and axiological needs noted above. Beyond the intermediate ends is an ultimate end, the subject matter of religion and philosophy. This placement of eco-