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Abstract

Economics places human activity outside of nature and nature devoid of man. The Enlightenment enabled the industrial revolution. Electric processors have brought about the post-Industrial revolution, and whilst science flourished the social sciences failed to explore its implications and significance. What is called for is an ethos based on integrating the human-made environment into the natural environment and developing an economic framework looking through the lens of human impact.

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Human – Nature

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Introduction

Scarcity and opportunity costs are central to economic theory, albeit their domain is limited to market phenomena. Except for the likes of Thomas Malthus and Herman E. Daly, nature in its broadest sense is not an economic problem except for the resources it provides and the markets it makes. In turn, natural resource use and exhaustion is a matter of price and substitution, and ecosystem damage an externality. In short, economic theory places human activity outside of nature and nature devoid of man.

This is consistent with the ethos of "man's mastery over nature" shaped by the literature of the Enlightenment, including Adam Smith's *The Theory of Moral Sentiments* and *The Wealth of Nations*. Yet, looking at the major challenges facing humankind today – population growth, ecosystem security, food and water, and human health – are the hard and social sciences content to maintain the status quo, or is a new paradigm called for?

First Principles

The Age of the Enlightenment gave credence to breaking autocratic rule and accelerated growth of the mercantile economy. The battles to establish new forms of governance, individual rights and rationalize new social relations facilitated the blooming of democracy and free enterprise. Charles and Mary Beard document the historical record (Beard, 1939, Vol. II, p. 860):

> As in physical nature the flash of lightening always precedes the roll of thunder, so in human affairs the flame of thought has always gone before a transformation in the social arrangements of mankind. In Machiavelli, it presaged the triumph of the National State over the ruins of feudalism and the disruption of the Church Universal; in Montesquieu and Rousseau, the overthrow of absolutism; in Adam Smith and Ricardo, the flowering of capitalism; in Mary Wollstonecraft, the dissolution of the patriarchal regime; in Marx and Engels, the upswing of the world-wide proletarian movement; in Sorel, Pareto, and Mosca, the uprush of fascism.

The Enlightenment was not the first, nor will it be the last leap in human development brought on by technological advances, antiquated means of governance and social displacement.

Whilst the various schools of economic thought have emerged because existing theories could not sufficiently address critical issues of the day, economic theory as a body of knowledge has steadfastly held true to the ethos of the Enlightenment. The question facing us today is whether we see conditions for lightening to strike or whether we hear the roll of thunder.

Paradigm Shift

The rapid development and deployment of electronic technology as exemplified in the First War in Iraq heralded in the post-industrial revolution. Yet this phenomenon was barely recognized. As the hard sciences developed at a rapid pace, discussion of the rise of post-industrialism failed to challenge the social sciences to explore its foundation, significance and implications. In parallel, our socio-political discourse continued to see "The environment" as "out there," separated from the man-made environment, whilst our hubris leads us to believe "technology" is always the solution to our problems. As a result, the current narrative is limited to explaining events within the existing framework whilst our experiences tell us things are quickly changing in a fundamentally different way.

There are, however, perceptions of fundamental change as exemplified in the Club of Rome report *The First Global Revolution* (King, 1991), Alvin and Heidi Toffler's *Creating a New Civilization* (1995) and Michio Kaku's *Visions* (1997). Whilst they present a bold narrative of the socio-economic impacts resulting from radical changes in the world today, their understanding of how to concretely respond to these challenges is absent. Today, while the hard sciences are rapidly advancing by leaps and bounds and the social order is mutating into new configurations, the dominant philosophy and body of socio-economic theory remains trapped in past eras.

Man is a tool-making animal, that is, she is a technology builder. Growth of the human knowledge-base has always brought forth new technologies, and critical technology leaps have defined the mode of production – domestication, slave, feudal, mercantile, industrial, electronic. Correspondingly, our capacity to manipulate materials, chemicals and living organisms has become more complex and poses greater risks to natural systems, including human health and welfare.

This risk has expanded exponentially to the extent that although technology is the driver of human development, the human and natural environments have become the limiting factor to our success. Not only are we affecting our climate, we are changing the pace and scope of evolution, we are changing the chemical composition of our air, land and water, and we are have the potential to change the trajectory of human evolution itself. The sins of the past have become exponentially graver

Whilst John Maynard Keynes stated the truth that in the long-run we're all dead, this only applies to the collective "we" if we make the wrong choices as we appear to be doing today. To prevent this, we need to develop an ethos based on integrating the human-made environment back into the natural environment. To do so is less of a choice as it is a necessary adjustment to the trajectory of the world we have built.

The Wealth of Knowledge

Humans share with other living organisms the capacity to absorb sensory inputs from the world around us as the basis for action. What distinguishes humans from other animals is our capacity for higher order abstractive thought and the development of the

productive forces which enable more complex orders of socio-economic organization, that is, technology and complex social structures. From an economic standpoint, this has allowed the factors of production to move from a more primitive to an increasingly more sophisticated stage of development.

History reveals the development of thought, society and the productive forces move through both incremental improvements and huge leaps. This has not come without costs and risks, however. An integral component of our socio-economic development is the increasingly more destructive impact it has had upon the ecosystem of which we are a part. Our response has been to largely ignore the consequences of our actions, and to deny our responsibility for our environmental footprint until it has reached crisis proportion. The ethical questions before us are how do we evaluate the world around us and what are our responsibilities for the changes we are making?

Electric Shock

There is agreement we have entered an information age and the world has changed; yet there is debate over what this means. Some see it as the acceleration of the status quo, others as a fundamental shift driven by technological advances. My proclivity is the latter.

What distinguishes post-industrial technology from its predecessors is it has become thoroughly electronically mechanized, an advance that has engendered a fundamental change in the machinery itself. Electronically powered transistor-based computer hardware and its enabling software make up the electrical circuitry that accomplishes work, be it on Main Street or on Wall Street. Whereas machine tools of prior eras mechanically imitated physical labor functions by utilizing various sources of power, today's machine tools reproduce mental labor functions where the source of power is also the source of mechanization. That is a quantum leap, literally.

These post-industrial technologies have radically transformed our capacity to assemble, manipulate, move, and store information, products, and electrons. They have also provided the means to increase efficiency, product reliability and niche marketing across all economic sectors, albeit in a disproportional manner. The productivity gain resulting from this technological advancement propelled the heretofore static service sector past its manufacturing counterpart as a generator of employment and profits.

In addition to redefining labor and its relationship to work, intelligent machinery has also redefined social relationships. Cell phones have transformed reflective open spaces from shared space to pathways for mobile private telephone booths. Couples sit in a café absorbed in a tweeting 140 character conversation, contact with nature turns toward a "destination" event in the park, and the social dialogue and political debate gravitates toward citing data lacking context as the basis of decision making. From an economic standpoint, short product lifecycles and ubiquitous advertising has accelerated the consumption cycle. From an ethical standpoint, civil society has lost contact with the natural world, imagining that real nature is a polar bear on an iceberg.

"Intelligent machines," the product of scientific advancement and a highly trained, albeit leaner workforce, are now the driving factor in producing wealth. This venture into areas we have not gone into before also brings greater risk and complexity. Nuclear powered generators use fuel which is highly destructive and creates waste that is indestructible. Yet, we're expanding production even though we don't know how to safely store the rubbish. DDT and Agar, products of the industrial era, were banned because of their toxicity to animals and their ability to permeate the food chain. These chemicals were an advance over their forerunners and a stepping stone to chemicals made today.

In today's world we have the capacity to alter chemicals, materials and animal species on an atomic and subatomic scale, alterations which are complex, potentially irreversible and without precedent. This significant leap in knowledge has a profound effect upon production and waste cycles from womb to tomb and thereafter. Scientific advancement, and particularly that in the quantum, computational and bio-molecular fields, has presented the economic community with the challenge of rationalizing the costs of human impacts on natural systems. This forces us to reconsider the impact of our actions both on ourselves and on the ecosystems that support us. Is it time for us to focus on resolving the issues which we don't know, rather than confidently basking in the light of what we do know?

Economics to Live By

Gross Domestic Product is an attractive, yet constrained indicator for measuring economic performance. The limitations of GDP start with those of economic theory, our inability to quantify production externalities and other non-market parameters such as the quality of the air we breathe. But, there is no indicator to measure the full economic cost of the impact of human activity on the environment, information that is critical for meeting the major challenges facing human society.

National Geographic magazine (Kolbert, 2011) introduced an intriguing graphic conceptualization of the contribution of population, affluence and technology to total human environmental impact (H_i) using UN data to measure population (P), world GDP to measure affluence (A) and patent applications as a proxy for technology (T), where:

$$\mathbf{H_i = P \times A \times T}$$

It concludes that since 1900 world affluence and technology have grown faster than population and all three are growing exponentially.

The concept is informative, but it is nothing more than a first order visualization of human impact in general. That does not necessarily mean the basic concept is not useful to economic theory or a candidate for use in applied economics, and, if used, "total human impact" will need to be clearly defined in economic terms. As GDP does not include costs and values that cannot be monetized, patents are not a proxy for technology performance, and population growth is exogenous and already imbedded in the data, other variables need to be considered not all of which can be monetized.

Having defined Total Human Impact as our relationship to the world ecosystem, H_i is dependent on: consumer consumption (C) and waste disposal (W_c); industry investment (I), waste disposal (W_i) and level of technology maturity (TL_i); government purchases (G), waste disposal (W_g) and level of technology development (TL_g); and, private and public sector changes in land and water use[1] (R_u), air, land and water pollution[2] (R_p), and loss of biodiversity (R_b). This leads to the following conceptual framework:

$$\mathbf{H_i = (C + W_c) + (I + W_i + TL_i) + (G + W_g + TL_g) + (R_u + R_p + R_b)}$$

This formulation looks at human actions in terms of economic value where impacts are measured as avoided future damage.

Consumption, investment, government expenditures and a portion of waste disposal including clean up come from the GDP accounts. Waste disposal also includes the damage and adaptation costs of the release of harmful substances outside the market structure. Technology, the universal answer to all of our economic problems, is not well understood. The cost of technology development, procurement and maintenance is included in GDP. The cost of technology which is not calculated is the avoidance and future costs of technology failure.[3] The economic cost of pollution, the environmental cost of changes in land use, and loss of biodiversity are difficult to monetize. Pending theoretical developments or the discovery of methods to determine environmental costs, proxies for these values must be found.

Economics, Naturally

Exchange is the pathway by which all living things develop. Plants convert kinetic energy into a stock of energy; plants and animals convert this potential energy into a flow of energy. But, this is the realm of science, not economics. To the economist, exchange is a transaction, the deliberate transfer of value between actors. How transactions occur and what constitutes the price is a question of the structure of the market and the nature of value. In this context, the laws of supply and demand are absolute and price is the product of scarcity and need. The outstanding questions are: what is value, how is it represented, and what is necessary to make the market meet societal norms and expectations?

These are not easy questions to answer. To start, ethics, our moral values, are not an option. They are imbedded in our thinking simply because we respond to things we perceive through our actions and reflect upon the consequences of our perceptions, thoughts and actions. Values in this sense are an integral part of our world view. As a result, moral values are imbedded in economic theory, but they are not part of our theory;

[1] This includes land-based changes to wetlands, rivers and streams, barrier islands, riparian buffers, etc.
[2] This contamination of artesian wells and other subterranean water sources.
[3] Avoidance cost is determined by the technology readiness level, in this case, the product has demonstrated it has the ability to withstand catastrophic damage prior to being placed on the market. Had the technology imbedded in the cut-off valve gone through this process, the BP Gulf oil spill most probably would not have occurred.

they are exogenous. The extent of their influence and whether their presence is overt or covert is our responsibility.

The ethical components of the predicament economics finds itself in are: what is the common welfare, what are the roles played by the public and private sectors, and what is the value of necessities that cannot be marketed? There are no easy answers to these questions we can agree upon, and the introduction of human impacts and the cost of these impacts only adds complexity to the answer to these questions, a situation we cannot avoid.

The measurement of the impact of human activity on the environment (H_i) is primarily an economic matter, whereas the structure, development and vulnerabilities of ecosystems are in the realm of science. This is the boundary of our areas of expertise. What we can learn from our scientific colleagues is we must consider impacts in the context of the very long term. To do so might simplify things. Not all decisions require everything be monetized or near term as exemplified in the most recent assessment report of the U.N. Intergovernmental Panel on Climate Change (IPCC, 2007). Methods are being developed incorporating use of non-monetized, scenario-based assessments alongside monetized economic data to reach viable conclusions.

These are the methods, but what about the theory?

Economics is more than a description of how the economy functions; it is also a guide to action. As stated earlier, the laws of supply and demand are absolute. How prices and quantities are set are not. They depend on how the markets are structured, that is, what costs are included, the degree of competition, the availability of substitutes, and other factors. Yet, discussion of market structure is completely ignored by practitioners of prevailing economic theory, a critical flaw that must be addressed. Any discussion of human impact, monetary policy and finance, and other non-corporate economic policy matters is severely disadvantaged absent the ability to posit fundamental changes to current market structures.

Neoclassical theory is interested in how markets work. It is the theory of the firm which has been mutated to affect better marketing and engender greater consumption. It has reduced the world to that of corporate and consumer activity, and then explains the rest of the economy through this lens. Yet, people do not especially care about maximizing their utility, they care about getting on with their lives, a decent income, job security, and being happy and having fun. They're far from an economic animal. Governments are concerned with security, public welfare, and transparency. They do not respond to markets, they are the market. The economy is not about corporations and consumers, it is about promoting growth and stability, the supply of adequate resources, goods and services, and it is about the future. Neoclassical theory cannot accommodate all this so it reduces the world to what it can.

The reality of market structure is not confined to preventing monopoly, promoting competition, or privatization. Market structure must ensure all monetized costs are accounted for and reflected in prices, that economic efficiencies are captured, and that

actors cannot circumvent the market. Whereas the perfect market in Neoclassical terms is free of regulation and other impediments to profit maximization, what is required is a market structure that maximizes human welfare and ensures the ecosystem endures. By necessity this will require rules, regulations and oversight which, while impinging upon profits and affecting consumption, will unleash human potential and engender a sustainable and secure future. Much of this is already being done. The next step is to develop the economic framework looking through the lens of human impact.

In addition to focusing on market structure, the governmental and scientific sectors need to be more comprehensively developed, and a coherent economic land, air and water framework established within the existing body of economy theory. These matters are beyond the scope of this paper, and an outline of the issues is provided for comment.

What is to be done?

H_i policy development is a matter of science and economics. Actualization of H_i policy is a matter of application, law, regulation, recommendations, and best practices. Implementation is a matter of funding and other necessary resources. The scientific and economic theoretical constraints imposed on H_i policy are:

1. Economics:
    a. theory has not incorporated the economic role of government and the value of its services and their impacts;
    b. production externalities are not internalized and consumption externalities are largely ignored, albeit market-based measures have been developed in a limited number of cases; and,
    c. study of income distribution, severe poverty and the profit from rents needs to be rekindled.

2. Science and Technology:
    a. the externality of early technology application has not been integrated into policy and decision-making;
    b. consideration of technology reversal (destruction, neutralization) is not built into the decision-making process; and,
    c. the capabilities and constraints of a given technology readiness level are not considered when introducing technology into the market and assessing its environmental risks and permitted uses.

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