

NATURAL CAPITALISM, GROWTH THEORY AND THE SUSTAINABILITY DEBATE

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This paper explores links and gaps between the popular debate over sustainability, neoclassical and endogenous growth theory, and the “natural capitalism” argument.

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In this paper, I explore the links between growth theory, the sustainability debate, and the “natural capitalism” argument. I also point out areas where they are in contradiction with each other.

Section I summarizes the modern arguments of traditional neoclassical and the new endogenous growth theories, section II the sustainability debate which has arisen primarily from environmental and social concerns, and section III the “natural capitalism” arguments. In section IV I look at unresolved questions which arise from comparing these three.

I. Neoclassical and endogenous growth theory

Neoclassical economics has historically been more focused on explaining short run microeconomic patterns such as how prices are determined than on dynamic models explaining growth and change over time. Neoclassical growth theory is best expressed by Solow’s Cobb-Douglas production function showing diminishing returns to capital and labor along with an exogenous technological factor. Income (Y) is a function of the levels of capital (K) and labor (L), the returns to each of them (β and $1-\beta$), and an exogenous technological factor, A .

$$^{(1)} \quad Y_t = A_t K^{1-\beta} L^\beta$$

The absence of natural resources as a separate, and potentially limiting, factor of production implies that (1) technological change can substitute for even nonrenewable resources and (2) market pricing will achieve an efficient allocation over time of all resources. In fact, Solow was quoted in Herman Daly’s *Steady State Economics* (1977) as saying “The world, can, in effect, get along without natural resources...”

The new endogenous growth theory (Romer 1994, 1986, see also Pack 1994) differs from a “Solow style” growth model primarily in the lack of diminishing returns to capital. This is based on either an increasing variety or quality of machinery or strong external economies from investment in new capital. Technology is no longer assumed to be exogenous to the economy and the growth process. But the argument still is focused on technology, capital and labor, without a special role for natural resources. The debate seems to be primarily about what drives technological change and whether it contributes to convergence or not.

Empirical analyses of growth across many countries has contributed to the search for new explanations of growth rates. In particular, there have been new developments which raise questions about the relationship between economic growth and income or wealth inequality. Whereas traditional theories posited a tradeoff between equality and growth, the evidence points strongly in the other direction (Aghion, Caroli and Garcia-Penalosa, 1999). This lends support to some of the social variables in the sustainability model, below.

II. The “Sustainability Model”

Some economists have attempted to broaden the concepts of economic growth and development by considering the natural environment, the economy, and society as inextricably interrelated. Each has its own capital stocks which must be sustained in order to continue producing “quality of life”, which is a larger concept than GDP.

Capital stocks include not just traditional manufactured capital (private and public), but the stock of natural resources (natural capital), accumulated human skills and knowledge (human capital), and social capital. The last is an intangible somewhat akin to the positive role of institutions in institutionalist economics, including the legal system, adherence to values such as honesty, and the level of civic participation. Sustainability relates to the maintenance or enhancement of these various capital stocks.

A widely used definition of sustainability was developed by the United Nations’ Bruntland Commission:

*“Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.”*¹[1]

Jonathan Harris of the Global Development and Environment Institute at Tufts University separates sustainability into its economic, environmental, and social components among which conflicts and tradeoffs may arise.

“An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.

“An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting nonrenewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.

*“ A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and participation.”*²[2]

²[2] Harris, Jonathan, pp. 5-6.

Conflicts may arise between these when political accountability, for example, collides with the preservation of atmospheric stability. Particularly in developing countries, providing adequate food and water to everyone may cause damage to the ecosystem. Sustainability is therefore an extremely normative concept because it does not automatically resolve these trade-offs in the way that the neoclassical economic model does (Howarth and Norgaard 1993, Norgaard 1990). This helps to explain why many economists have been uncomfortable with the term (see Lesser and Zerbe, 1995, for example).

The World Bank, and its chief economist, Joseph Stiglitz, have expanded the concept of true national savings which take account of the depletion of natural resources, and the United Nations has chosen to average per capital GDP with life expectancy, adult literacy, and school enrollment ratios to derive a Human Development Index (HDI) on which countries may be compared (see Harris for more discussion of these).

The Genuine Progress Index (GPI) developed at *Redefining Progress*^{3[3]} begins with the GP but includes estimates of household work and environmental services, as well as subtracting the costs of crime, lost leisure time and decay in the stock of environmental resources. While GDP trends upward from 1950 to the present, with occasional dips, the GPI increased much more slowly through the mid 1970's and has declined since 1980.

While the Commerce Department has computed expenditures on environmental cleanup for several decades that can be subtracted from GDP, a proposal to call attention to this via a footnote was struck in Congress recently. Lest anyone believe that the collection of numbers is scientific, members of Congress from coal producing states took the lead in killing this provision. This is an excellent example of how interest groups do more than shape policy... they shape the picture of economic reality in which the policy debate is based. 4[4]

Hart Indicators' *Guide to Sustainable Community Indicators*, developed with grants from the U. S. Environmental Protection Agency's Office of Sustainable Ecosystems and the Lowell Center for Sustainable Production, University of Massachusetts at Lowell, portrays the economy, environment, and society as three interlocking circles in one diagram and circles within circle in another. The environment is the circle within which society resides, and the economy resides in the circle of society.

In another Hart diagram natural resources are at the base of our pyramid, with human resources resting on top of them and built capital at the top of the pyramid. Indicators are focused on the carrying capacity of three types of capital stocks: built and financial, human and social, and natural capital. The natural capital at the base is divided into traditional natural resources (inputs into the production process such as wood, metals, and water), ecosystem services (such as water filtration and the conversion of carbon dioxide into oxygen), and the bounty of nature (mountains, seashores, rainbows, bird songs) that we enjoy directly. This is an important division, as we will see below, because the potential effects of technology on each of these are very different.

Many communities around the country have used the concepts outlined at both *Redefining Progress* and in the Hart Indicators guide as blueprints in developing community indicators oriented to either quality of life or sustainability. 5[5] These focus not only on environmental indicators, but expand the scope of economic indicators to encompass inequality measures, and

3[3] An interdisciplinary group which has economist Richard Norgaard on its Board of Directors.

4[4] Rowe and Anielski, 1999.

5[5] For more, see the Center for Colorado Policy Studies section on sustainability at web.uccs.edu/ccps

include social capital measures such as participation in elections, library circulation or books purchased per capita, and measures of neighborliness and trust in government.

III. Natural Capitalism

Many of the ideas of the sustainability model have been put in economic terms in *Natural Capitalism: Creating the Next Industrial Revolution* (Hawken, Lovins and Lovins, 1999). Hawken/Lovins do not recognize social capital/institutions explicitly but focus on four forms of capital (natural, human, manufactured, and financial). 6[6] They, and many environmental economists,7[7] are particularly concerned with the lack of differentiation by many economists between the ability of technological innovation to substitute for many resources and inputs and the inability to substitute for the “envelope” within which we live.

This life-sustaining environment cannot be treated as an equal factor of production, according to Hawken/Lovins, but is a limiting factor underlying all production. Many of these issues were raised decades ago (Daly, 1977). He wrote that using only the circular flow model to understand the economy is like trying to understand an animal in terms of its circulatory tract without recognition that it is connected to the larger world by a digestive tract on both ends. Like the animal, our economy takes in and processes natural resources, consumes some of them, and produces waste which goes back into the environment. Recognition of the effects of waste, as well as the non-renewability of some resources, has been slow in coming to traditional economics but is a central theme of *Natural Capitalism*.

While traditional neoclassical as well as endogenous growth theories have emphasized maximizing labor productivity, the natural capitalism model focuses on ways to increase resource productivity. Increasing labor productivity, and thereby average wages, relies on the use of more capital and/or more natural resources per worker. But if certain natural resources are in fact the limiting envelope, their use must be made more efficient.

According to Hawken/Lovins present day industrial capitalism “is a financially profitable, nonsustainable aberration in human development... [which] does not fully conform to its own accounting principles. It liquidates its capital and calls it income. It neglects to assign any value to the largest stocks of capital it employs – the natural resources and living systems, as well as the social and cultural systems that are the basis of human capital.”8[8]

However, they believe that assigning monetary values to natural capital will not remedy this problem. Many of the services we receive from living systems, like oxygen, have no known substitutes at any price. A 1997 “best estimate” of the value of direct services from natural capital was close to the annual (measured) gross world product of over \$30 trillion and would yield a stock value of over \$400 trillion. In terms of present value, as explained above, this would be much lower

Hawken/Lovins seems to rely heavily on a realization by businesses that many unexploited resource productivity gains exist and would be profitable. This process would be greatly aided by a tax system that rewarded environmentally sound activities and penalized waste. Without such publicly driven incentives, one must rely on the notion that businesses are not now profit-maximizing in the ways that they could if better educated as to various cost-saving techniques.

6[6] Note that the classification of financial assets as an equivalent form of resource capital is in sharp contradiction to the traditional economic approach, which stresses that money is a lubricant, but not a productive resource in itself.

7[7] See , for example, Krautkraemer, Jeffrey A. 1998. “Nonrenewable Resource Scarcity”, *Journal of Economic Literature* XXXVI: 4, December.

8[8] Hawken, et al., p. 5

There is undoubtedly some truth to this, but the question is how rapidly and how extensively change would occur that is not already occurring. In other words, is “natural capitalism” a viable business strategy for enough firms to make a difference?

Much of what we term “economic growth” is actually “uneconomic growth” to Hawken/Lovins. In particular, over a fifth of the U. S. nine trillion gross domestic product is actually “waste” in their terminology. This includes a host of activities which they see as producing no value for consumers, including environmental cleanup, time lost in traffic, highway accidents and substance abuse.

Of course, a libertarian would answer that people abuse drugs and alcohol specifically because they get “value” from doing so. Convincing them to refrain from these wasteful activities may not be so easy. And activities which Hawken/Lovins include as waste include lawsuits, unnecessary health care, and administrative overhead in the U. S. health care system. While most would agree there is substantial room for improvement in each of those areas, it is hard to argue that they are entirely composed of waste (perhaps assigning 50% of the dollars expended to waste would be a more reasonable estimate?)

An interesting aspect of the natural capitalism model is its suggestion that we shift from an economy where well-being is based on the acquisition of goods to one where more of well-being is based on a flow of services. Purchasing the services of a washing machine, which is both maintained and metered by the manufacturer, gives them an incentive to build in efficiencies and durability in ways that the current market structure does not. It also would eliminate the great instability in consumer durables purchases, stabilizing that portion of the economy. This would require a major rethinking of both consumer and business strategies, but along a line that has begun to occur already with equipment leasing in some areas.

IV. Comparing the Approaches

In the neoclassical model, natural resources are not treated as a constraint because (1) prices adjust to encourage efficient use of scarce resources and (2) technological change can create new resource uses and efficiencies as it has in the past. The critical debates are over how to encourage technological change and whether inequality has positive, negative, or no effect on growth rates.

Both the sustainability model and the natural capitalism approach disagree fundamentally with full reliance on principles (1) and (2). They are in agreement that the low present value of highly valuable stocks in the future precludes the market mechanism from handling this problem effectively. At a discount rate of 10%, a million dollars of value one hundred years in the future is worth only \$72 today. This translates into an assumption that it would be economically efficient to destroy one million in future value for \$72 of consumption today. Lowering the discount rate would raise the threshold, but it may not be possible to use a rate low enough to give an economic justification for preservation.

Harris points out that we have implicitly chosen how to allocate resources between generations once we use a discount rate (see also Howarth and Norgaard, 1993). Lesser and Zerbe (1995) suggest the use of “generational accounting” (Auerbach, Gokhale, and Kotlikoff, 1994) to compare burdens on future generations with benefits in the present.

But there is an increasing consensus that it may not be appropriate to use the market system to make judgments about irreversible decisions and/or very long-term impacts.

The assumption that all natural resource constraints can be dealt with by human knowledge and technological progress in neoclassical economics is in direct contrast to the differentiation of

resource categories seen in Hawken/Lovins and the sustainability literature. The concept of the “envelope” portion of the environment, in contrast to natural resource materials used in production, appears very close to that of ecosystem services and the bounty of nature as used by Hart Indicators. Mainstream economic journals such as the *Journal of Economic Literature* have published work raising some of these same issues (see Krautkraemer 1998) but its influence on mainstream economics as explicated in textbooks, for example, is still marginal.

Hawken/Lovins appear considerably more optimistic about increased resource productivity by profit-seeking businesses than the sustainability movement writers. In contrast, writers in what I have termed the “sustainability model” imply more need for public policies which create negative or positive incentives for businesses to behave in a different manner with regard to natural and human resources.

Conclusion

The architects of the GNP concept, including Simon Kuznets, understood the limitations of the new national income concept they had developed. By the 1970's, a separate set of expenditures on environmental clean-up were developed so that those who wished might subtract them out of the total. But ease of use by the media and the public, as well as a recognition by various business interests that it might best serve their purposes to leave it alone, have enshrined the GDP measure in a place far more exalted than was ever intended.^{9[9]}

A focus on broader measures of well-being and all the capital stocks (human, natural, manufactured and social) which contribute to well-being would fundamentally alter neoclassical economics. It would introduce ambiguities which confound the logic of maximization and mathematical models. Sustainability is not a value free concept and not a clearly defined concept, which does not lessen its importance to the central questions economists address.

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^{9[9]} For more, see Greenwood, Daphne “Accounting for Growth: Do the Numbers we Have Determine the Questions we Ask?”, Working Paper 101, Center for Colorado Policy Studies, which was presented at the 2000 Southwestern Economic Association meetings at web.uccs.edu/ccps.

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