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Sustainability and Surplus

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Abstract:

In this paper we present two new concepts for studying sustainability. The first is the idea of an environmentally adjusted surplus(ES). The classical concept of surplus is revised to approximate the total available discretionary income for the society under ordinary (capitalist) growth process.ES is an operationalizable concept. We demonstrate this here via a simplified but illustrative exercise. Work with large data sets employing social and environmental accounting will yield sharper and more accurate results. Our second contribution is the concept of a modified stationary state. Recognition of the economic uncertainty and limits to calculations leads naturally to the idea that both individual and social rationality is bounded. Under the bounded rationality hypothesis MSS is a more appropriate concept for sustainability than the ones currently adhered to. This includes Boulding's definition of steady state as well.It is our hope that with these new concepts at hand the analysis and policy prescriptions regarding a sustainable future can proceed more realistically. Together they also suggest a new research program for environmental and ecological economics.Some components of this program will be identifying and estimating ES sectorally and in aggregate, mapping the transition paths to MSS, and most importantly asking what modifications and changes in our socio-economic and political institutions are necessary to make this transition possible. Since the MSS is to be achieved in the future but choices must be made now, an inter-temporal allocation problem between the present and future generations is involved. We need to ask: "How will the rights of future generations be defined, and how will enforcing those rights influence allocation decisions?" This is one of the most important institutional questions in a global setting as well. In the absence of appropriate international institutions with enforcing authority, nation states will define and enforce these rights in a haphazard manner. In the worst case they will do nothing. In order to avoid such an impasse, we have proposed the somewhat novel concept of a modified stationary state of a sustainable econom**y.** The illusion that ever-higher levels of consumption will yield ever-higher levels of satisfaction provides support at the individual level for a system of indefinite expansion that in the long run is simply not viable. It is not viable because, in a world of finite resources and pollution-absorption capacity, any system that depends on continuing expansion of production or "throughput" cannot be sustained. Ultimately, such a system will have to be a "modified stationary state" which is possible in a world where agents have bounded rationality but also forward looking abilities.

Introduction

In the quarter century following World War II, the Western world experienced a period of prolonged prosperity. Strong productivity growth fueled rising living standards in the United States, Europe and Japan. Starting in the early 1970s, however, a period of sluggish growth set in, with real wages remaining stagnant in the United States and higher unemployment rates becoming the norm throughout the West. At the time of this writing (December 1992), a sluggish economic environment remains pervasive. Nevertheless, capitalism has always tended to move in long waves of alternating prosperity and stagnation, and there is strong evidence that a new period of strong expansion may begin in the 1990s. [1]

One of the principal factors driving that expansion, we will discuss some of the others later, is the collapse of the Soviet Union and Eastern Europe, and their incorporation into the capitalist world economy (CWE). After an unsettled transition period, this process promises to open up substantial new markets and investment outlets. On its surface, the era appears to be one of the ultimate victories of capitalism. As Robert Heilbroner has pointed out, however, the major threat to capitalism has always been from its own internal contradictions rather than an external source (1989, ------). And neither the collapse of its communist adversaries nor its approaching period of prosperity so far seems to be capable of confronting the environmental crisis that capitalist expansion has spawned.

[1] The timetable, of course, is only intended to be suggestive. The theory of long waves in its current state of development does not have precise quantitative power.

The capitalist economic system is strongly oriented toward economic growth. This is true of the system as a whole, of its institutions, and of the pattern of individual incentives and motivations it generates. Accumulation tends to become an end in itself. Whether corporations seek to maximize profits, revenue or market share, they acquire an inherent dynamic of growth. Individuals, meanwhile, in a system that routinely generates inequality and invidious comparisons, are constantly seeking to improve their consumption standards, even though for the society as a whole there is no evidence that beyond a certain point rising material standards are associated with higher levels of satisfaction or happiness (it is doubtful, for example, that Americans felt better off in 1992 than they did in the mid-1950s).

The illusion that ever-higher levels of consumption will yield ever-higher levels of satisfaction provides support at the individual level for a system of indefinite expansion that in the long run is simply not viable. It is not viable because, in a world of finite resources and pollution-absorption capacity, any system that depends on continuing expansion of production or "throughput" cannot be sustained.[2] Civilization can be sustained on earth only if a system of sustainable economic activity can be put in place. Ultimately, as we will argue below, such a system will have to

[2] Inspite of claims by some neoclassical economists about resources being in principle non-finite (e.g. with appropriate price signals "backup" technologies might be developed to exploit resources, space exploration might lead to the relaxation of resource constraints) such a vision ignores the second law of thermodynamics.

be a "modified stationary state" (MSS), a state which is incompatible with the capitalist system.

In contrast to the nineteenth-century vision of Marx, who saw the fundamental contradiction of capitalism as that between workers and the owners of the means of production, it appears far more likely that the critical contradiction of the system will prove to be that between its internal dynamic of expansion and the limited capacity of the environment to provide the inputs it requires and, especially, to absorb the wastes it generates (see Weisskopf, 1991, for an incisive presentation of this argument). Although capitalism has strengthened its position as the world's dominant mode of production and social formation, it has yet to find a method of coping with the negative externalities generated by its growing production, externalities so severe as to bring into question the sustainability of human life on earth.

If present trends continue, for example, we can readily imagine a future world in which most human activities are carried out at night to avoid the deadly effects of sunlight unfiltered by an ozone layer, in which global warming has contributed to the flooding and disappearance of massive coastal areas, in which natural forests have disappeared, and in which radioactive nuclear wastes are piled up about the planet for lack of a method of safe disposal.[3] In view of this outlook, a strategy for dealing

[3] Of course, in a class divided society other apocalyptic visions are possible. It may be that only the working class (especially the unskilled and the low-paid like the riffs and raffs in

with the environmentally destructive consequences of an unbridled capitalism appears imperative. The nature of such a strategy will depend on the seriousness of current conditions (the state of the world) and the outlook for the capitalist world economy.[4]

In this paper we argue that there is a secular-declining tendency for the resources available to ameliorate or check environmental deterioration. These resources must ordinarily come from the discretionary spending capacity each economy generates, the spending capacity that represents the difference between national income and the essential consumption requirements of its population. This discretionary spending capacity, which we call the surplus, tends to diminish over time because the growth of population and production raises disproportionately the costs of congestion, pollution and production even as essential consumption standards are adjusted upward to reflect rising consumption norms.

If, as we argue later, the surplus tends to decrease over time, it becomes vital to take advantage of any period of sustained economic prosperity, when temporary factors may lead to an expansion of the surplus sufficient to more than offset its tendency toward secular decline, to institute protective measures for the environment and to initiate institutional changes that can contribute to the attainment of a sustainable

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Kurt Vonnegut's *Player Piano)* will be exposed to the environmental dangers while the rich remain indoors.

[4] Political will is obviously a major ingredient of this. However, under the scenario described in the previous note the rich may only want to engage in 'defensive' environmental strategies at best without changing the mode of production and consumption.

economy in the future. Only by developing a theoretical framework that enables us to get beyond the appearance can the rationale for taking appropriate actions become apparent. With that end in mind, we devote one section of this paper to the concept of the surplus adjusted for natural resource depletion, environmental pollution and other externalities.

In that section we argue that in the industrialized economies, under normal conditions, there is a secular tendency for the rate of growth of the environmentally adjusted surplus to decline. Under some circumstances the environmentally adjusted surplus may decline even in absolute terms. Since we conceive of the surplus as that share of a society's income that is above and beyond its socially-defined subsistence requirements (the minimum required for a decent existence as determined by a society's own standards), the surplus can be thought of as the income that is available for any social purpose above and beyond subsistence, or as society's discretionary income. Such discretionary income can be used and has been used historically to build monuments, provide luxury consumption for the elite, fight wars or carry out investment, among other uses.

As discretionary income, the surplus can also be thought of as constituting a flow of resources that can be used, potentially, to address a variety of threats that society may face. A military threat provides an obvious example. The existences of a surplus means that a society has the resources to take countermeasures to avert a threatened invasion or make it

less costly should it take place. In parallel fashion, the presence of a surplus allows a society (or human society in general) to take measures that will preserve the environment that makes human life possible. If, as we argue, that surplus tends to disappear over time, similar measures in the future might well require depressing the living standards of a substantial portion of the population below subsistence. Any effort to do so would tend to usher in an era of intense social conflict and would have a much smaller probability of success. For that reason, it is critical to take advantage of the possible coming boom in the capitalist world economy to protect the environment and thus the future of human life on earth.

The analysis of this paper, then, will proceed as follows. In the following section we will present an elaboration of the argument. Next, we will present our framework for estimating the environmentally adjusted surplus and the reasons for believing it is subject to secular decline. The thrust of our argument is that a window of opportunity will open during the approaching period of prosperity that must be seized if human life on earth is to be protected under decent social arrangements. In the final section, we will explore the meaning of sustainability as a modified stationary state. We consider there both the classical conception of the stationary state and the implications of Kenneth Boulding's proposal to minimize throughput. Motivated by these ideas, we propose a more general concept of a modified stationary state (MSS). While substantial measures can and must be taken during the era of a likely capitalist ascendancy to alleviate the

global environmental crisis, over the longer-run, non-capitalist forms of social organization will have to be adopted to preserve the species in a manner which to paraphrase Keynes will not be morally and esthetically indecent.

An elaboration of the argument

Kenneth Boulding's classic essay, "The Economics of the Coming Spaceship Earth," was published in 1966. Boulding observes there that primitive men "imagined themselves to be living on a virtually illimitable plane" (p. 121); there was always a new frontier to go to when resources became depleted or the wastes generated by production and consumption befouled the local living space. With the growth of population, the depletion of resources and (especially) the straining of the environment's capacity to absorb wastes, however, the limitless plane is increasingly being transformed into a "closed sphere." The sojourn of human beings on earth, that is, is increasingly like that of travelers on a spaceship engaged in interstellar flight. All the available supplies had to be loaded on board before the flight began, and without recycling resources would soon run out, the environment made foul, and usable space diminished and ultimately choked off by the accumulation of wastes.

According to Boulding, the change in objective circumstances requires a change in the character of economic behavior and analysis. The open economy of the past, which Boulding calls the "cowboy economy," was "associated with reckless, exploitative, romantic and violent behavior" (p.

127). The closed, spaceman economy of the future, by contrast, must reflect the fact that "the earth has become a single spaceship, not an unlimited reservoir, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy" (p. 127). Twenty-seven years after his essay appeared, the logic of Boulding's argument has become increasingly evident, but the change in economic behavior and analysis for which he called has yet to take place.

The seriousness of the environmental problems confronting the earth is well known. The reduction in the ozone layer has reached alarming proportions, increasing the amount of harmful radiation from the sun that reaches the surface of the earth and the incidence of skin cancer. Global warming may sharply affect agricultural production and threatens coastal regions (large parts of some countries) with inundation. Deforestation, the loss of biological diversity, the accumulation of toxic and nuclear wastes (for which safe methods of disposal have yet to be found), the deterioration of air and water quality, and the growing solid waste problem are just some of the issues confronting the earth's population. Yet as Boulding argues, the increase in throughputs (production, consumption and the generation of wastes) is still considered the objective of economic activity.

Suppose, however, human wants and needs could be satisfied with a minimum of throughputs. Suppose, for example, that each person had an

indestructible house that he/she loved--- a house that experienced no depreciation. There would be no need to construct new housing and, with a stable population, house construction and repairs would fall to zero, reducing GNP accordingly. Yet the material well being of the population would be much greater. At the same time, the fall-off in production activity would diminish the generation of wastes.

Stated in this extreme form, the example we have presented is of course unrealistic, but it nevertheless serves a heuristic purpose. If economic activity is to be environmentally benign, it must be oriented wherever possible to creating and maintaining an optimal capital stock with minimum throughputs. This is the truth, Boulding argues, that our conventional economic analysis with its emphasis on growth fails entirely to grasp.

Boulding does not explore, however, the implications of his argument for the transformation of economic institutions and the relations of production, nor does he address the questions concerning the stationary state to which his argument inevitably gives rise. The "cyclical ecological system which is capable of continuous reproduction of material form" need not, of course, be a completely stationary state. Nevertheless, a stationary state in which throughputs are minimized and recycled provides the most favorable condition for attaining this system.[5]

[5] Later we present the concept of a modified stationary state. Under the assumption of bounded rationality neoclassical minimization hypothesis to which Boulding still adheres becomes untenable.
Hence a new conceptualization of the steady state becomes necessary

If we value the preservation of human life in a cyclical ecological system and the avoidance of such grotesque adaptations as those we have noted, then we must ask what type of social formation, what relations of production, are most likely to ensure them. Since capitalism is the dominant social formation and mode of production, even more so with the collapse of the statist economies of the Soviet Union and Eastern Europe, as well as the retreat from statism in the third world, it may be appropriate to focus initially on the implications of the capitalist system for the development of a stationary state. The prognosis in this regard is not favorable.

The capitalist system is driven by the search for profit. In part this means minimizing costs. Since costs cannot be driven below zero, however, and since in practice they will inevitably be higher than this, the main avenue to the expansion of profits has been and continues to be the expansion of sales volume--that is, the expansion of production or throughputs. This has led historically to an amazing development of technology and of prosperity, at least in parts of the world. Capitalism has been a system well suited to the expansion of production, to the cowboy economy. In the spaceman economy, however, the nature of the economic problem will be transformed. There the nature of the problem will be to optimize the condition of the capital stock, including the mental and physical condition of human beings, with a minimum of throughputs. Capitalism appears to be quite incompatible with this objective. Moreover,

as a system, which continually generates inequality and a striving for material consumption to overcome all the dissatisfactions it engenders, capitalism continually recreates a psychological need for expanded material consumption. Thus both the system itself and its psychological impact reinforce a tendency toward continually expanding production and consumption, a tendency quite at odds with the requirements of the coming spaceship earth. If we think in terms of a *transition* to a stationary state, however, rather than in terms of the stationary state itself, then capitalism can play a critical role. That is because the transition must be characterized by a significant growth of output.

The apparent contradiction between a low-growth state (the modified stationary state discussed below in the final section) requires high-growth periods, leading to it's disappearance, when we consider the prerequisites for a stationary state. To the extent that people feel deprived, whether in absolute terms or in relation to others in their own country or abroad, they are unlikely to willingly support a steady state economy. Thus, for example, people in the less developed countries will not support the freezing of their incomes at current levels that are far below the per capita incomes of the industrialized countries. Within the latter, moreover, persisting problems of poverty and equality must be addressed before an environmentally benign program can be implemented in its entirety. Theoretically, the category most appropriate for understanding the choices available is what we call the environmentally adjusted surplus. Before examining the technical

aspects of this concept, let us consider the prospects of the CWE in order to delimit the scope of future action.

In the U.S., the interest rate on thirty-year government bonds fell from the 14-15% range in the early 1980s to the 7-8% range in 1992. In Europe, the EC countries tied themselves for the most part to the conservative monetary policies of the Bundesbank, the German central bank, and the overall tendency has been one of disinflation despite a temporary counter pressure associated with the costs of integrating East Germany into the German economy. In general, a falling cost of capital in the ICs can be expected to raise rates of return on investment, thereby encouraging it.

The backlog of infrastructure spending requirements in the ICs, another factor favoring the growth outlook, reflects a number of historical and social forces. First, substantial infrastructure spending in the 1950s and 60s made further spending appear less urgent. Second, sluggish economic growth and runaway entitlements spending in the 1970s and 80s created severe budgetary pressures at national and local levels. With budget deficits already large and popular pressures making higher taxes politically difficult (or supply-side ideologies making them appear undesirable), it was for IC governments to defer spending wherever it could be done most readily. Thus roads and bridges were not maintained properly, airport construction badly lagged the increase in air travel, mass transit languished, waste treatment facilities failed to match the need for them or the

possibilities created by new technology, and a growing number of cities experienced traffic gridlock. As the real costs of deferring infrastructure spending have mounted and become more evident, popular pressures for action have risen correspondingly. At the same time, falling interest rates have lowered the prospective interest costs of infrastructure spending, raising the likelihood of action.

In addition to favorable influences associated with growing markets and falling interest costs, growing competition in the CWE has raised productivity and thus the prospective profitability of investment. Spurred by the aggressive competition of foreign multinational corporations (MNCs), especially those of Japan and U.S. manufacturing corporations were forced to slash costs to survive in the 1980s, when a strong dollar added to the pressures they confronted. In the l990s, international competition has become increasingly severe in the service sector as well. Combined with the real estate slump, the savings and loan crisis and general over indebtedness, the impact of competition on the service sector in the U.S. has driven the same sort of restructuring the manufacturing sector experienced a decade earlier. Such restructuring--and the pressures leading to it have been present to a greater or lesser degree throughout the CWE--raises prospective profit rates, encouraging investment.

Finally, profit rates are also raised and investment encouraged by the increasing power of capital relative to labor. Many companies have the option of transferring operations to countries with low labor costs, affecting activities ranging from credit card processing to manufacturing. Moreover, companies can legitimately point to the competitive pressures created by foreign rivals to restrain the wage demands of their workers. In a closed economy, the growth in profits relative to wages might be expected eventually to lower aggregate demand, one of the basic internal contradictions of the capitalist system. But with the expansion of the world market as peripheral or semi peripheral regions like the former Soviet Union are absorbed into it, rapid growth creates investment opportunities in the LDCs, and new institutional forces raise the profitability of investment, the impact of this contradiction is rendered minimal. Thus the profit share can rise in the ICs without their markets being affected adversely. That is, under the favorable conditions now emerging in the world economy, high profits in production will not diminish sales opportunities.

Our argument has touched on some of the major forces that appear likely to drive an investment boom at the turn of the century in the LDCs as well as in the ICs. With so many factors playing a role, however, we have not been able to take note of everything. Additional considerations, for example, include the likelihood of a relatively abundant supply of fossil fuels, energy price increases for some time, and the accelerated

introduction of new technologies that lower production costs or raise demand (the introduction of such technologies tends to occur in wave-like fashion and to be spurred by a general investment boom). The outlook for a worldwide capitalist boom means that for an extended period of time, the economic surplus will rise or be sustained at a high level, offsetting for that interval its secular tendency to decline. And since the surplus can be thought of as representing societies' discretionary spending capacity, the boom period will present a critical opportunity to address the ongoing environmental and social contradictions that the CWE faces.

The environmentally adjusted surplus and sustainability

The concept of the surplus can be useful in exploring the relationship between the economic process and sustainability. We define surplus as society's discretionary income (Lippit 1992, 1985; Khan and Parvin 1984). Therefore, the existing value of the surplus gives the upper limit of society's capacity for sustaining a certain rate of growth, together with the amelioration of environmental deterioration. In order for this measure to be of relevance here, however, the concept itself needs to be modified through the inclusion of (external) environmental costs and the change in the values of environmental assets in the *income* part of surplus. Lippit (1992) points out a number of problems with an earlier definition of the surplus as "the difference between total output and the socially necessary costs of producing total output (Baran and Sweezy, 1966). The objections center mainly on the definition and measurement of "socially necessary costs of

production." Baran and Sweezy, for example, treat all governmental expenditures as part of the surplus, implying that none of them represent socially necessary costs of production. Yet it is difficult to understand how production could be maintained in the absence of expenditures on transportation, education, security and so forth. If these were not provided through the public sector they would have to be provided privately; in either case they represent necessary (albeit indirect) costs of production.

By overstating the size of the surplus, the approach used by Baran and Sweezy tends to overstate the capacity of society to engage in "discretionary" spending, an issue of special concern with regard to environmental protection. Moreover, by ignoring completely environmental costs, the framework provided by Baran and Sweezy cannot in unmodified form even begin to address the critical environmental issues that have received growing public recognition. For our purpose, this makes it necessary to formulate the concept of an environmentally-adjusted surplus (ES), which takes into account both resource depletion and environmental pollution. We argue that the size of the ES circumscribes the scope for action in a given society.

We define surplus (S) as

$$S = Y - C_{ess}$$

Where, Y = national income and

C_{ess} = the essential consumption of the entire population.

ES is defined as a further refinement of the above concept.

$$ES = Y - Cess$$

Where, YA = national income adjusted for environmental externalities.

It should be pointed out that the category "essential consumption" introduces an element of ambiguity since two reasonable observers may disagree on what constitutes essential consumption. It can be argued, however, that given a social minimum (such as, for example, a poverty line), we can unambiguously calculate a surplus and compare its value over time or across countries. Such comparisons can give us qualitative, ordinal information (surplus is more or less in this period than previously, country A has more surplus than country B, etc.) which can be useful in answering such questions as, "Does the economy of country A have more flexibility in dealing with environmental problems than that of country B?" or "Do we have more economic flexibility in dealing with the environmental problem now than we did in the fifties?" The point is analogous to the use of other indicators such as GNP. They are imperfect indicators but allow us to have insights, which are not readily available otherwise.

In calculating ES, the environmental impacts are to be taken into account. Broadly speaking there are two ways of taking these into account. One is to construct a set of physical accounts, as Markandya and Perrings (1991) have done in the case of Botswana.

A second way, which we take for the time being, is to use monetary accounts by valuing the environmental impacts. Since markets do not exist

for many such impacts, various techniques for estimating them have been developed. Some currently in use are:

l) hedonic price methods

2) contingent valuation methods

3) travel cost methods

4) dose response methods

In addition to the lack of properly defined markets, estimation problems are created by the uncertainty regarding the future demands for and supplies of important natural resources, government intervention and other distortions, and lack of information. As Perrings and Markandya point out, however, "...by and large most of the key services can be valued to an order of magnitude." For the purpose of our present argument, we need not measure ES to the last decimal point (even if that were possible). However, the concept should be clear from the identity below:

ES = YA – Cess

= Y - ED + DEA - Cess

Where, ED = environmental damages in the current period, and

DEA = net change in environmental assets (= end of period stock - beginning of period stock).

The concept of the environmentally adjusted surplus is closely related to the idea of "sustainable income" accounts (Markandya and Perrings, 1991; Peace and Turner, 1990; Bartelmus, 1990; El Serafy, 1989; El Serafy and Kutz, 1989).

Again the development of such accounts along with the existing SNA is a challenging task, only partially undertaken at present. Here we would simply stress that once a proper set of such accounts is available we would then know exactly what magnitude of ES is consistent with sustainability.

In the rest of this section we argue that a) there are good reasons to believe that the ES has been declining in many of the advanced capitalist economies and possibly in the world as a whole, b) that where it has not been declining a secular tendency to decline will appear sooner or later, and c) as a consequence, the scope for discretionary policies to create a sustainable future is either declining now or will begin to do so within a few decades. If there is a prosperous period ahead which may push ES up somewhat, then that period may well be the last opportunity under capitalism for doing something to create sustainability.

Using data from the national income accounts, U.S. Bureau of the Census and the Conference Board (A Marketer's Guide to Discretionary Income), Lippit (1992) concludes that the net surplus in 1986 was roughly $895.0 billion or 23.7% of NNP. This estimate naturally does not take into account ED and EA. What would be a rough estimate of ES for the same year? Recently Herman Daly and John B. Cobb, Jr. (1989) have calculated what they call an index of sustainable economic welfare (ISEW). The index itself, as the authors admit, is based on some heroic assumptions. One of these, relevant for our purpose, is the imputation of the cost imposed on the future generations by the depletion of natural resources

(Daly and Cobb, p. 416). In the following derivation of a rough estimate of ES we avoid their problem by assuming these costs to be zero.
Since these costs, uncertain and difficult as they are to gauge, are certainly positive, our estimate of ES, ceteris paribus, is biased upwards.

We can also try to get a fairly reasonable upper bound estimate of ES by avoiding some of their more ambiguous estimates of environmental costs. As a result, what we do below is to take the conservative approach of accepting only the immediate costs of pollution estimates and rejecting the more uncertain long run depletion of resources estimates. In other words, we assume that EA = 0. For most countries of the world today this is a very conservative assumption. We exclude, by fiat, the costs of deforestation, loss of species, rising energy costs with a possible shift to nuclear power and its consequences, de-certification and various other real costs in this exercise. Although later calculations can and should take these factors into account, our purpose here is to demonstrate the validity of the argument (and the urgency of taking appropriate countermeasures) even when highly conservative assumptions are made concerning some of the variables involved.

Our estimate of ED is also reduced by our inclusion of the costs of water, air and noise pollution only, and by our exclusion of all other sources of ED. For 1986, Daly and Cobb gave these costs, in 1972 constant dollars, as 15.3, 22.4 and 4.6 billion respectively. Together they add up to

$42.3 billion. So the absolute size of the net surplus calculated by Lippit must be reduced by at least that amount and S - ES is at least $42.3 billion; in all probability the difference is much more than this figure. Even this figure, which does not include defensive private expenditures on health, etc. (Khan and Parvin, 1984) because of pollution, is larger than the GDP of some small developing countries.

On the other hand, the attempt to calculate ISEW (Daly and Cobb) also shows that the efforts to control pollution in the 1970s did pay off in terms of reducing ED and thus of increasing ES. Hence the policy direction both in the short run and in the long run should be clear; the sooner policies for pollution abatement and general environmental cleanup are adopted, the better the situation will be for attacking the long run problem of sustainable growth.

Theoretically, the surplus will decline absolutely if

$dy/dt < d(ED)/dt + dCess/dt$, assuming $DEA = 0$.

Since in a mature capitalist economy the rate of growth inevitably slows down (Kalecki, ,Steindehl,), the left hand of the inequality will show a secular decline. At the same time the R>S> is likely to increase in both its components unless policies fundamental to capitalist growth are altered. It seems implausible that the rate of consumption will slow down in a market society with intense alienation at work compensated by consumption and feverish sales campaigns. Decline in environmental damages will require permanent defensive expenditures, which will add to the essential

consumption of this society, but at best it will be reduced to zero in any realistic scenario. Hence it seems to follow that the likelihood of ES declining severely is high. This is the meaning of the proposition that the (environmentally adjusted) surplus has a secular tendency to decline.

Even if the decline in size of the S and ES may be checked worldwide through a new burst of prosperity, there is still the problem of the distribution and use of the surplus. If part of the surplus is reinvested in plant, equipment and infrastructure, and part goes to luxury consumption, then without explicit directives for employing environmentally-defensive investment (i.e., investment that will protect the environment) the decline in the ES may still not be checked to the extent necessary to create sustainability. Thus the key to sustainability is the use of the ES in ways that will provide adequate safeguards for environmental assets (at a level that is sufficient to guarantee this). Conceptually, the conditions for a modified stationary state (MSS) can link surplus and sustainability.

Sustainability as modified stationary state

From the foregoing discussion of ES we can discern two different sets of issues in ameliorating the environmental crisis. These are brought to the fore by the two corrective features added to the idea of ordinary surplus in the previous section.

First, there are problems connected with the current period deterioration of the environment (ED) and the policies (e.g., effluent taxes, etc.) that can be undertaken to correct them, period by period. Most

environmental regulations that are currently in effect or are being proposed address this aspect.

In addition, there is a second set of issues connected with the problem of maintaining the stock of assets, including the stock of natural assets, in the economy over time. Even though the short run policies noted above will undoubtedly have their effect on the stock, it is important to separate analytically the long-run set of issues in order to focus on these properly. In other words, what Boulding has termed the economics of the spaceship earth must be explored seriously. This is what we attempt to do in the remainder of this section.

Boulding (1966) formulates the problem in terms of minimizing throughput. In the extreme case, this could lead toward a stationary state twhich might be called a throughput-minimizing stationary state or TSS), making a sustainable economy possible. This of course rests on the assumption that the solution to the minimization problem gives us a vector of productive assets which can be used to replicate the economy, period after period. If this is not true then sustainability is impossible, no matter what policies are followed. In what follows, therefore, we assume that: For an economy, E, defined by m producers, n consumers, assets A, technology T and policy parameters p, suppose it is true that E(Xn, Ym, A, T; p) p → E' (X'n, Y'm, A', T') is sustainable where X and Y signify the consumption and production sets respectively. E' is the state of the economy which minimizes throughput.

Even if it is technically feasible, however, we may not be able to achieve this TSS because of political and institutional rigidities under the current system. An alternative is to introduce the concept of a modified stationary state (MSS). In this case an upper bound can be placed on the level of acceptable throughput. We first set the target of reducing the throughput over the planning horizon so that at the end of the period we are at or below this upper bound. Once this target is achieved we plan to keep the throughput from exceeding the upper bound.

In other words, given a planning horizon T and a throughput (flow) vector y at an instant we set a target $O < Y^* < Y$ so that as $t \rightarrow T$, $Y \rightarrow Y^*$ from above. For all $t > T$, $O < Y < Y^*$. This way of defining the MSS relaxes the requirement of *minimizing* throughput. We can think of it as a weak sort of bounded rationality conception of the idea of achieving a sustainable level of growth. It is a weaker condition because we do not rule out the possibility that Y^* may minimize throughput as $t \rightarrow T$. Hence the target setting itself becomes an exercise in bounded rationality as opposed to the logic of optimization of neoclassical rationality.

Summary and Conclusion

In this paper we have presented two new concepts for studying sustainability. The first is the idea of an environmentally adjusted surplus. The classical concept of surplus is revised to approximate the total available discretionary income for the society under ordinary (capitalist) growth process.

ES is an operationalizable concept. We demonstrate this here via a simplified but illustrative exercise. Work with large data sets employing social and environmental accounting will yield sharper and more accurate results. This looms as an urgent task now and in the future. Our second contribution is the concept of a modified stationary state. Recognition of the economic uncertainty and limits to calculations leads naturally to the idea that both individual and social rationality is bounded. Under the bounded rationality hypothesis MSS is a more appropriate concept for sustainability than the ones currently adhered to. This includes Boulding's definition of steady state as well.

It is our hope that with these new concepts at hand the analysis and policy prescriptions regarding a sustainable future can proceed more realistically. Together they also suggest a new research program for environmental and ecological economics.

Some components of this program will be identifying and estimating ES sectorally and in aggregate, mapping the transition paths to MSS, and most importantly asking what modifications and changes in our socio-economic and political institutions are necessary to make this transition possible. Since the MSS is to be achieved in the future but choices must be made now, an inter-temporal allocation problem between the present and future generations is involved. We need to ask: "How will the rights of future generations be defined, and how will enforcing those rights influence allocation decisions?" This is one of the most important institutional

questions in a global setting as well. In the absence of appropriate international institutions with enforcing authority, nation states will define and enforce these rights in a haphazard manner. In the worst case they will do nothing.

Related to this is the seemingly technical question of discounting the future. As the foregoing discussion shows, however, this is really a political- ethical choice problem, one that is at best informed by our technical knowledge about the ecosystem of our planet. The valuation of the environment also poses complex problems. Calculations based on the strict self-interest of the human species may or may not lead to the same practical conclusions as those ascribing intrinsic value to nature. The underlying ethical assumptions, however, are quite distinct. Ultimately, atomistic self-interest as a value is increasingly inconsistent with any reasonable idea of sustainability. Thus "surplus" as a purely technical concept is still an instrumental one. What to do with the environmentally adjusted surplus depends on the fundamental values of the global community. It is in this terrain that the significant strategic questions regarding sustainability need to be debated and discussed in the future.

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