Sustainable Growth: Dominating Debate and an Emergy View

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ABSTRACT

Sustainable growth is a controversial concept in the context of sustainable development. In this paper the concept is examined critically, from a general and an emergy point of view. The discussion brings out a new dilemma put to global society in relation to the use of resources. There is a pressure for more physical growth to attend a growing demand of human populations, with increasing demands for higher standards of living that implies in a increased destruction of natural capital stocks but, this destruction cannot keep going on because there is a high risk situation if the biosphere biological and physical limits are overcome. Therefore in addition to checking just economic growth facets, the human system need to be put in spotlight in a more holistic approach to the problem of environmental degradation. The thermodynamic foundation of the emergy concept underlines the physical growth limitations. However, information is not thermodynamically limited in the same way as energy and matter. If money is considered an information flow it may grow decoupled from energy and matter. If sustainability is viewed from a pulsing perspective, there may be periods when money can grow and still be within the frame of sustainability.

INTRODUCTION

The interface between economy and environment is continuing to receive a lot of attention especially in the face of the declining environmental quality. Traditionally, the economic perspective has put socio-economic wellbeing ahead of environmental concerns, disregarding the complex interactions between the environment and economic activities crucial for accounting for environmental degradation being experienced today.

Economists advocated for economic growth as a means to solving the problem of scarcity and alleviation of poverty which is said to be a big problem from a socio economic point of view (Keynes 1931). On the other hand environmentalists have questioned the place “economic growth” has in a world that seems to have used resources and deposited waste at a rate faster that the replenishment and assimilative rate of the environment, respectively. Therefore the concept of economic growth theory is not only incompatible with the works of the environment but also a divergence from sustainable development principles.

Inherent in the concept of sustainability is the desire to preserve or maintain a desirable condition on a specified temporal and special scale (Brown et al 1987). In this regard, economists’ models require that consumption reaches a certain desirable level and kept constant, therefore preserving utility at that level. However this conception of sustainability is what has been rejected by environmentalist who argued that such utility violates other forms of utility, which is the “environmental utility”, represented by “regenerative and absorptive” demands of the environment. Therefore the controversial aspect of sustainability seems to stem from the choice of the thing to preserve, which can take a number of forms depending on field in question. Perhaps the best context of “sustainability” in an all encompassing form was set out by the Brundtland report which put the “ethicosocial and biophysical” limits of economic growth on the forefront (WCED, 1987).
The Brundtland report acknowledged the need for economic growth to fight poverty whilst at the same time cautioning against unlimited growth since the current growth could not be sustained without compromising the future generations’ ability to use environmental products and services, which became a working definition of “sustainable development” concept. In this definition is the recognition of the physical and ethicosocial limits of economic growth. To date, this report has opened up a number of discussions regarding the interdependency of the environment and economy. It is against this background that this paper intends to reconsider the debate about sustainable growth by drawing lessons from the emergy analysis framework. The paper will start by an overview of the general sustainable growth debate, followed by a section with some aspects from emergy perspective on the subject.

**SUSTAINABLE GROWTH DEBATE: LITERATURE OVERVIEW**

The issues that are dominating in the interface between environmental demands and economic growth debate include the limits of economic growth, differences between qualitative growth and quantitative growth and their role in sustainable development, the role of money in economic growth and the role of perfectly functioning markets and prices in environmental management.

There is a general consensus amongst the environmentalists and ecological economists that economic growth has limits. Economic growth is limited by the “regenerative and absorptive capacity” of the environment (Daly 1977, Daly 1990). Daly (1987) elaborated on the biophysical limits of growth embodied in the laws of thermodynamics and the cost imposed on future generations. On the other hand environmental economists are in agreement with the fact that economic growth can not be forever since resources are limited in their supply. However, “pure economists” have limitation of growth in the market mechanisms of supply and demand which regulates resources’ use and the assimilative capacity of the environment. Therefore the protection of the environment should be left to the market regulating mechanisms. To this extent the term sustainable growth was introduced in an attempt to define and integrate economic growth into the environmental sustainability framework. A number of arguments have been coined by economists over the years in support of the sustainable growth concept as listed below;

i) The level of economic activity is not the only determinant of resource depletion and assimilative potential of the environment (World Bank, 1992 and Radetzki 1992). Output composition and technological development that ensure minimizing resource use and waste materials and gases into the environment are equally important. Any economic level that comes with use of cleaner technologies and resource efficient technologies has the potential to ensure economic growth without burdening the environment. Sustainable growth therefore becomes growth that minimizes material use, energy and reduces solid, liquid and gaseous waste at every level of economic activity. In this regard Akao and Managi (2007) demonstrated optimal and feasible conditions for a sustainable economic growth coupled by increasing environmental quality. However important in their analysis was the fundamental condition that negative physical growth rate be attainable in the long run through use of less material intensive and cleaner technologies.

ii) Economic growth as measured by Gross Domestic Product (GDP) includes both qualitative and quantitative growth (Behrens et al, 2007). Qualitative growth may be a result of substituting products for services and using improved technologies as discussed. Some positive results have been reported in this regard. For example a study by Behrens et al (2007) reviewed that material intensity on a global scale decreased by about 25% between 1980 and 2002 indicating the effectiveness of decoupling strategies whilst GDP grew by more than one third in the same period.

iii) Economic growth has a positive impact of generating wealth. As per-capita income increases citizens become more conscious of the need for a cleaner environment (Martinet and Ritillon
This idea borrows a lot from Maslow’s hierarchy of needs which states that, before you satisfy the lower level of needs which are the basic needs namely food, clothing and shelter you can not move to the higher level of needs which in this case is the demand for a cleaner environment and or the conscience of depleting resources at a rate faster than the replenishment rate. This is evident today in the developed world which seem to have successfully satisfied the lower level of needs and are on the higher level of a cleaner environment, for example.

iv) However it has been shown that even developed nations that have satisfied the lower level of basic needs and with properly enforced environmental laws are not immune to environmental degradation. This has led to some environmental economists to conclude that economic growth is a necessary condition, but not sufficient (van Ierland et al 2002). This implies that economic growth objectives need to proceed to a certain threshold after which checks and balances becomes necessary to align economic growth to environmental demands.

v) Degradation of the environment has also been observed to be a result of poor enforcement of environmental standards which seems to be more common in poor nations (Grossman, 1995). Therefore increased income is important in mobilizing resources important for enforcing environmental standards which is taken to be an important factor in mitigating degradation by greedy business people for example.

vi) Perhaps the more pronounced argument by economists is the role of prices and markets in protecting the environment. Market failure is taken to be the main reason for environmental degradation. Therefore creation of such markets which have been proven practically through the use of market instruments such as permit systems, Pigouvian taxes, is that in a money economy where markets are functioning properly, prices provide self adjusting mechanism that ensures that no resource will be overused (van Ierland et al 2002, Grossman, 1995). For example, as a resource become overused, its supply declines pushing up the price of such commodity. This has an effect of lowering demand giving an opportunity for such a resource to replenish itself. Therefore the challenge is to have polices that ensure perfectly functioning markets for environmental goods and services.

Environmental economists have provided models that are in use in many countries that seeks to establish markets that internalizes environmental costs for traditionally unmarketed environmental goods/bads and services. Economic instruments such as tradable permits, pigouvian taxes, ambient taxes, user charges and deposit refund systems are in use, albeit, with different levels of success (e.g. meeting the desired target of emissions or enforcement and compliance). The tools are said to have an advantage of allocative efficiency, cost effectiveness and can also promote technological development as firms invest in cleaner technologies to reduce the cost of allowance purchases. However, tools such as the pigouvian taxes have been criticized for failing to induce change in behavior by firms who often pollute as high as they can afford to pay. Of note also is that the ways some of the economic tools are designed seem to be diverging from the economic theory from which they are based. For example the high entropy waste limits are set by regulators, for example an emission cap, which is often a reflection of the physical limit of growth in the sense that the cap denotes what we ought not to exceed, governed by the “regenerative and absorptive capacity” of the environment. Therefore the price system can not function on its own to manage the environment that functions under ecosystem principles.

The above arguments seem to be saying that economic growth is a necessary condition to meet socio economic objectives but not sufficient to reverse environmental degradation. Checks and balances embodied in policy response are needed to ensure that i) markets for environmental products and services functions like markets for other goods that are perfectly functioning, ii) environmental standards are set so that precaution is taken against any increasing level of economic activity that is not commensurate with technological development, iii) technology develop fast enough to contain excessive extraction of resources and control dirty outputs from economic activities and processes.
The economists arguments have however been dismissed as missing the core of the physical and qualitative limits of the environment. Daly and Townsend (1993) argued that the concept of sustainable growth in all the forms discussed above was self contradictory. It’s simple; there is no space for growth. The evidence of global warming, ozone depletion and health impacts associated with air pollution, for example, call for a stop to economic growth which is the core anthropogenic influence on such environmental degradation. Economic growth will further decrease net primary product of photosynthesis (NPP) since the historical tendency of economic growth to reduce global photosynthesis (Daly and Townsend, 1993). Therefore the growth space has been used up, if not overused.

Daly acknowledged that the qualitative component of economic growth had a place in this world, choosing to call it “economic development” rather than growth, as growth implied physical changes. Therefore, like economists, technological developments seem to be the ultimate answer to the challenges of meeting economic objectives whilst remaining within the confines of the environmental works.

Money Growth and Economic Growth

It has been debated amongst economist that growth in money will have an impact on growth on real output. With the preceding discussion concluding that economic growth is limited biophysically it is therefore important to assess the likely impacts of economic growth induced by monetary growth. The use of money, taking over from batter systems, has been used as means of exchange portraying some value of commodities or services. However this role has increasingly been changing, with money being used to manipulate economic policies. Monetary policies (manipulating the stock of money in an economy) have been used in many countries to meet economic growth objectives. It has been argued by classical economists such as Alfred Marshal that changing money stock will not have a not increase economic growth but decrease it through inflationary pressures. However Tobin (1965) argued that the impact of money growth will be to increase inflation and therefore making it expensive to hold money. As a result of the increased cost of holding money, economic agents will prefer to hold capital goods which increase output in the long-run. After Tobin a number of papers were written on this subject with mixed evidence on how changes in money stock can impact economic growth. Most of these papers reverted to the classical economists’ argument (Barron 1995, Siddrausky 1967). This subject will be discussed further in this paper from an emergy point of view.

SUSTAINABLE GROWTH FROM AN EMERGY PERSPECTIVE

Sustainable growth is not previously addressed in emergy literature, to the authors’ knowledge. Below three aspects are presented which may be important from an emergy perspective on the concept of sustainable growth.

Physical Growth Has Limits

Emergy connects to the view of ecological economics that the economy is a subsystem of the ecosystem (or an emergent system from the natural resource base). When diagramming systems it becomes apparent that the economy is connected to the physical resource base, see figure 1. And the physical resource base has physical limits. The energy flow from the sun is flow-limited per time unit, which gives limits in energy supply. Other energy sources (fossil fuels, et cetera) are storages which per definition are limited, when the storage is empty it is empty. Materials circulating due to the energy flows are also storages limited in amount.
**Figure 1.** Emergy evaluation of the Swedish society 2002 (Hagström & Nilsson 2004). Italic numbers in the unit billion Swedish crowns per year (E9 SEK/year). Other numbers in billion EmSEK per year (E9 EmSEK/year). GNP=Gross National Product.

**Pulsing**

A wanted stable steady state is often intrinsic in definitions of sustainability. However, some argue that pulsing is the normal state for systems (Odum et al. 1995). If pulsing is a general systems pattern, sustainability is likely to have different features in different stages of the pulsing cycle. Odum et al. (1995) divide the pulsing pattern into four stages: (I) growth, (II) stagnation, (III) decline, and (IV) slow regeneration (figure 2). Odum & Odum (2001) gave different suggestions and strategies for sustainability in the different stages. In the pulsing context, during phase I it is observed a wanted outcome of continuous growth. This growth may be considered sustainable if it is part of a pulsing pattern that is sustainable as a whole.

**Decoupling of Physical and Monetary Growth**

Though saying that physical growth is limited in figure 1, this does not necessarily mean that there is a limit for the growth of money. It may be that money is not a true measure of value, but rather a tool for allocation of value. Monetary flows are one type of information flows, and information flows are not limited by the 1st and 2nd laws of thermodynamics in the same way as flows of Joule and kilograms are. This means that money, at least in theory, can grow independently from physical flows. There is at least to some extent a decoupled relation between the physical and monetary flows. In emergy evaluations of nations it is an observed fact that the ratio emergy per money is decreasing over time. This is usually explained by the fact that the physical driving forces over time are getting a little more expensive to extract. The easiest extractable sources are exploited first. Another explanation, however, may be that a decreasing emergy per money ratio over time is maximizing empower for the system. This means that growth of money maximizes the systems performance, and maximize its competitiveness and/or maximum empower. As described above growth of money may also only maximize competitiveness and/or maximum empower in the first pulsing phase, the growth phase. It may also be that within the above four phases, a phase internal pulsing pattern of money may increase the system function.
In the context of the pulsing pattern mentioned above, and in this decoupling perspective, money may vary in any of the four phases. H. T. Odum and E. C. Odum (2001) foresee a different role for monetary institutions when humanity leaves the current growth phase. They even suggest empower to guide the work of bank institutions, which are suggested to take value out of money in the same rate as empower declines.

Other research showing that information is not limited in the same way as energy and material is for example the description of the succession in a rain forest by Jørgensen (2000) see Figure 3. In the early stages maximization is for energy input and increasing biomass. When energy and/or matter becomes limited (often called the “mature stage”), the succession continues by building complexity in information terms.

CONCLUSION

It is apparent from the general debate and emergy point of view that economic growth has limits, at least regarding matter and energy. Whilst prices and markets play an important role in ensuring the internalization of external costs, they seem to be limited by the availability of such markets and what the environment can afford at any given time. When the source of resources is exhausted there is little that can be done by markets and prices to have it back which is a check point for those advocating for limitless economic growth. The question then is what can replace economic growth to maximize human welfare or do we need to maximize it at all? This question has partly been answered by the economy and environment decoupling strategies which seek to reduce resource use and waste creation at different levels of economic activity. However, completely doing away with physical growth seems impossible especially in the light of growing populations, ever increasing demand for higher standards of living and depreciation of capital goods. Therefore in addition to checking economic growth facets,
the human system need to be put in spotlight in a more holistic approach to the problem of environmental degradation. The thermodynamic foundation of the emergy concept underlines the physical growth limitations. However, information is not thermodynamically limited in the same way as energy and matter. If money is considered an information flow it may grow decoupled from energy and matter. If sustainability is viewed from a pulsing paradigm perspective (Odum et al., 1995), there may be periods when money can grow and still be within the frame of sustainability.

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