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Production in Context: The Concept of Sustaining Production.

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Abstract:

One of Herman Daly' s most important contributions is his effort to place economic activity within its proper biological, physical and social context. Building on Daly' s work and the seminal work of Nicholas Georgescu-Roegen, this chapter develops a concept of production that views context as central rather than ' external'.

This contextual view of production sees production as inextricably linked to the social and environmental contexts within which it takes place. It makes evident that those processes that take place outside of the production process itself, but that sustain input generation, material transformation and waste absorption, are critical to the creation of output and to the benefits derived from output generation. These processes are referred to as sustaining services. A production process that maintains or enhances sustaining services can be considered a sustaining production process that creates wealth. Production that undermines or destroys them diminishes wealth.

It is argued that the transition to such a context-based view of production is essential as the consequences of the reductionist, context-less view of production have become all too evident in large scale economic, social and environmental deterioration. This has also profound consequences for economic policy and its broader social and environmental implications – from communication, public participation and regulation to incentives.

Key Words: Production theory, sustainability, ecosystem services, social sustainability, flow/fund factors, economic policy.

Introduction

My first encounter with Herman Daly' s work was as a graduate student at the Universität Göttingen. At the time I worked in agricultural economics on production intensity related 'externalities'. These externalities were anything but 'external' to the farming communities that experienced levels of nitrate in their drinking water wells that far exceeded the standards recommended by the World Health Organization. The resulting policy debate had led me to the United States and to a simulation model (CREAMS) that could be calibrated to supplement empirical data to estimate nitrate emission functions of agricultural production. Herman Daly's work had raised questions about the scale of production – questions that resonated in the context of the expanding European Union and its agricultural policies. How much? How much of what? What is 'optimal' both in terms of scale and intensity? What are effective policies to arrive at

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such an optimal, second best, or desired level and mix of output? And what recommendations should be offered regarding production methods and best management practices?

The story that made an especially big impression on me was Daly' s recalling a graphic that was to be included in a World Bank report. It depicted a box labeled 'economy' within a larger box labeled 'environment'. After all, where did those things come from that made the generation of output first possible and where did they go, whether the end products produced or the emissions released and waste products left behind? As Daly related the story, every time an edited version of the report came back the 'environment' box had been removed. In the end, no graphic was included in the report - no context for the economy.

Since then, much work by ecological economics and other fields has focused on the side effects of our ever-expanding economy. Yet the production side of the debate has moved somewhat to the back burner. Scale is rarely questioned and even the desirable mix of output generation and input use is not much of a topic. Allocation, after all, is left to the market. This is especially true in the U.S. where the failure of the planned economies and the resulting affirmation of the superiority of unimpeded markets has diverted attention from such issues as sustainable production and social and environmental cost based pricing. And the planned economies certainly did not offer any useful insight with their complete lack of social and environmental context consideration that was evidenced in the widespread environmental destruction left in their wake.

It is therefore not surprising that, despite growing evidence of the environmental and social costs of economic activity, Herman Daly' s story is still relevant almost 40 years later: social and environmental context is still not commonly considered in economic theory in general and in the theory of production in particular. The most recent economic and environmental crises and their social and environmental impact are but one example in a long line of exhibits that illustrate the neglect of context systems. A considerable body of recent work has raised questions about the validity of the rational economic actor model of modern welfare economics (NEW) that forms the basis of the demand side of the model. Yet the supply side of the model has not received equal attention. As Georgescu-Roegen (1984) pointed out repeatedly:

" In contrast to the immense literature dealing with the utility function, … the production function formed the object of no critical analysis ever since Philip. H Wicksteed [1894] introduced it almost one hundred years ago by the slick tautology: the product being a function of the factors of production, we have P=f(a,b,c,…)." (pg. 22).

This chapter argues that it is critically important to attend to the work of developing a context-based concept of production especially in light of the power of aggregate product (final goods and service produced - GDP) as a driver of economic policy. The chapter begins with a brief review of key problems and recent advancements in production theory. It then offers an integrated, context-based conceptual framework of production that takes Georgescu-Roegen' s work as its starting point. This contextual view sees production as inextricably linked to the social and environmental contexts within which it takes place and makes evident that those processes that take place outside of the production process itself are critical to the creation of economic output and to the benefits derived from output generation. In fact, it is the context systems that sustain input flows, material transformation and waste absorption that first make the production

of economic output possible. A production process that maintains or enhances the underlying sustaining services that support its input flows and transformation capacity can be considered a sustaining production process that enhances the value of economic output. Production that undermines or destroys them is unsustainable and diminishes value. The value of production thus is not solely determined by its consumptive value nor is an increase in economic output necessarily valuable.

The context based view of production therefore changes the economic policy mandate from a strictly 'output protection' view to a recognition that production itself has broader social and environmental implications and thus consequences for economic policy. Four particular policy aspects are briefly discussed. They are: (1) the role of communication, (2) public participation, (3) regulation and (4) incentives. Addressing these aspects will be critical to a successful transition to a context based production and resultant policies that move beyond the growth and consumption mantra to long-term sustained production.

Output Without Context

Historically, production was a key focus for economics. Classical economists like Smith, Ricardo, Malthus, Mill and Marx all viewed production as central to economic analysis. A significant part of this analytical work related to the interaction between production and humans and natural resources. Production was viewed as embedded in a social (human) and environmental (natural resources) context that described constraints and capacities.

In contrast, Neoclassical Welfare Economics (NWE) has devoted limited attention to production theory. Its notion of output generation is chiefly driven by utility theory (consumption). According to this understanding it is the goal of satisfying consumer needs and wants (maximizing utility) that drives how much and what kind of output is generated. Since one of the characteristics of utility theory is non-satiation – more is better – output must grow. This shortcut equation of consumption = utility = social welfare has profound consequences. Its power is evident in our national accounts and the sheer hypnotic focus of policy makers on GDP (aggregate output measured in monetary terms). Not surprising, aggregate output has occupied a significant place in recent economic history despite the limited attention to its theoretical underpinnings. Output feeds the insatiable hunger of the demand side of the economy and thus fuels the economy itself.

The chief consequence of this view is that marketable output has value while non-market or un-used goods and services do not. Likewise, inputs invested in the production of marketable goods and services have value as measured in marginal product and marginal cost of production. Unused resources or those dedicated to the production of non-market household, community, subsistence and informal sector contributions are considered valueless. Production in this view is "any activity that creates present or future utility" (Frank 1994, pg. 311) with the underlying assumption of a steadily rising utility function.

This view also introduces a qualitative distinction between counted (valuable) and unaccounted for (valueless) production that promotes a preference for allocating resources to produce marketable product. According to this framework, decisions

regarding the prices and quantities of inputs and utility generating outputs are mediated by the market via the price system. Improvements in the production process thus focus on technological change and efficiency increases to reduce costs and increase output per unit of costly input. The predictable result is that " free" inputs are overused while the consequences of the underlying value biases remain invisible. The context within which production takes place thus remains at best a source of input streams and a recipient of output and waste streams with little concern for the impact of these delivery streams on the context itself.

The limitations of this notion of output generation and input allocation have long been recognized. Production is depicted as outputs being a function of inputs with no consideration for the production process itself or its social and environmental context. Changes in inputs, their transformation, or the context conditions of their delivery and use remain external to the purview of production. To address possible distortions in the efficient allocation of inputs or in the utility of outputs, negative externalities may need to be internalized. The internalization of externalities, however, demands a production concept that looks closely at the production process itself. This runs counter to the aggregation of inputs into broad categories of stocks of land, labor and capital. As Georgescu-Roegen argued, what is needed instead is a concept of production that pays far closer attention to the flows of useable inputs and to their impact on the capacity to generate future flows. Pasinetti describes the limitations of the NWE model of production as follows:

> " The model clearly has nothing to do with the phenomenon of production. The problem it deals with is the optimal allocation, through exchange, of a certain initial endowment and distribution of resources… It became necessary to shape the theory of production (which by its nature is concerned with flows) in such a way as to meet the requirements of a preexisting theory concerning the optimal allocation of certain stocks of resources." (1977, pg.25-26)

Georgescu-Roegen makes a similar point. He writes: "The boundary only identifies the process. It does not tell us the most important aspect, namely, what the process does." (Georgescu-Roegen 1984, p.23).

A somewhat different perspective on the shortcomings of standard production theory is offered by feminist scholars who focus on the valuation biases of production and their implications for social and environmental contexts outside of the boundaries of the production process (see for example Bernhard Filli et.al. 1994, Mies 1986, Ferber and Nelson 1993, O' Hara 1995b, 1997, 1999, Perkins 1997). According to this view, production does not take place in isolation, but draws instead upon a web of services provided in households, communities and the environment. The non-market, subsistence production and the productive and re-productive services provided in households, communities and ecosystems add value both to the production process and to aggregate output. The valuation bias associated with undervalued and neglected context systems leads to their overuse as unremunerated input flows and the restorative and reproductive work necessary to maintain them never enters productions cost considerations. The effects of input substitutions, such as longer work hours and time pressure, on ecosystems and on social relationships or on the engagement in democratic institutions remain

unaccounted for despite their consequences for both social and ecological context systems.

These same valuation biases also translate into considerable pressure to move activities out of households, communities, volunteer organizations and subsistence production and into the market where they are first assigned value. Sadly, those least able to shift activities into the market sphere, and those whose contributions receive low remuneration for their work, pay the highest price for the underlying distortions in value. Mary Mellor writes:

> "If payment is not made in economic terms someone will pay in other ways: they will die before their time, sleep on the street, be nursed by a relative, go without shoes, walk miles to the well." (1994, pg.3)

Within the human community women have most often paid the price for the neglected maintenance needs of input flows and transformative capacity. This is true even as subsistence services of support, care and nurture move from the invisible economy of households, communities and the environment into the official market economy of service sectors and manufactured ecosystems services. A longer commute, longer work hours, less time to socialize and increased demand for so-called time-saving devices all increase the pressure on social and ecological support services provided outside of the boundaries of economic production (Blomqvist et.al., 1996).

Similarly, the rapid deterioration of ecosystems and their ability to buffer, absorb and process the steady stream of emissions and waste is evidence of the price being paid by the non-human community. The list is alarming: an estimated 90 percent of large predatory fish are gone; 75 percent of marine fisheries are either overfished or fished to capacity; half of the world' s wetlands, temperate forest and tropical forests are gone; in drier regions more than half of the agricultural land is suffering some degree of deterioration and desertification; 40 percent of the world's population faces water scarcity and former United Nations Secretary-General Kofi Annan identified water as a key issues during the 2002 World Summit on Sustainable Development.

This points not only to the overuse, but also to the time dependency of the biological and social processes associated with sustaining human labor inputs and ecosystems services. As Herman Daly and others have pointed out, the notion that capital offers a substitute for land and labor without consequences or limits is deeply flawed (Daly 1997, 2008, Gowdy 2004, Gowdy and McDaniel 2000, Gowdy and O' Hara 1997). Substitution has consequences. Ecosystems services, for example, cannot be replicated without considerable expense and substitution attempts often fall short given our limited understanding of the complexities involved. And as impressive as the substitution of labor has been, particularly in the primary production sectors, even the most technologically sophisticated production process requires some labor input. In addition, the substitution of labor and pressures to increase labor productivity, have consequences as well. These include job-less economic recoveries, a growing bifurcation of the labor market and declining social engagement. What has been perceived as a substitution relationship is in fact a complementary one. The inside and the context of production, the valuable and the seemingly valueless, are inseparably linked.

Recovering Context

Several concepts have been developed to address the shortcomings of standard production theory. One approach brings the environmental context of production into view by adding emissions. Different products and production methods generate different emissions that are in turn associated with different external costs. Adding this 'external' dimension of production typically leads to a reduction in output levels below those that would be otherwise considered optimal or desirable (O'Hara 1984)[1].

Leontief's work in Input-Output analysis (1966), which represents each individual production process as a distinct description of input to output transformations, adds further detail to the analysis. The methodology makes it possible to depict production patterns as networks of processes described as interconnected input-output flows. As a result, production can be re-conceptualized as a network of processes and structural patterns (see also Scazzieri's task-process definition of production, 1993).[2]

In addition to adding detail about the production process itself, Input-Output analysis can also add context information. Ecological economists, for example, have used the methodology to describe the relationship between economic activity and environmental impact. One such example adds emissions coefficients to each production sector in a regional input output framework (Vazquez 2001). Natural resource accounts (NRAs) add further information about the supporting environmental context and/or the natural resource base that provides inputs to the production process and receives outputs and waste (Lange et.al. 2003, 2007). And Social Accounting Matrixes (SAM) add social context to the IO framework. SAMs link economic flows to the interconnections between production sectors, households, and primary inputs. This makes it possible to characterize the complementary relationship between output generation and consumptive activity. An increase in consumption requires that the socio-economic system increase its investment both in terms of capital goods and human activity (Zipf 1941, Duchin1998). IO, NRAs and SAMs thus offer a way to describe quantitative flows that make it possible to analyze complex scenarios of economic, social, and environmental change.

One of the well-know critiques of the IO model has been its fixed coefficient assumption and its inability to represent changing input-output ratios at different production scales. Recent studies, however, suggest that fixed coefficients may not be an unreasonable assumption. Average variable costs curves seem to exhibit constant returns to scale as changes in production levels are typically the result of entire operations being shut down and re-opened, which implies proportional changes in all inputs (Miller 2000).

Another context based analytical framework is the so-called Multi-Scale-Integrated- Analysis-of Societal-Metabolism (MSIASM) developed by Giampietro and Mayumi (2000a, 2000b, forthcoming, Giampietro 2003). MSIASM is a bio-economic model that investigates the constraints imposed on production by the structure of the human economy expressed as inputs in human activity and exosomatic energy. Total Human Activity (THA) is determined by population size and represents the endowment

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[1] This is true even if one does not follow the optimization logic of producing at levels where marginal revenue equals marginal cost.

[2] Building on Pasinetti's work on vertical integration (1977, 1981) the IO framework has also been extended to account for intermediate production and for the reproduction of capital inputs (Rhymes 1986, Gowdy and Miller 1990, Miller and Gowdy 1998).

of hours available for economic production and consumptive activity per year. The delivery of human activity includes required investments in reproduction, recreation and restoration that are necessary to sustain production and consumption thus taking account of the context of economic activity. Total Exosomatic Throughput (TET) represents the total energy dissipated by a socioeconomic system in support of the productive and consumptive activities per year. The two primary inputs, Total Human Activity (THA) and Total Exosomatic Throughput (TET) are disaggregated into productive and consumptive activity defined as the fractions of human activity and energy invested in economic production and consumption respectively. The model then further disaggregates productive and consumptive activity into three broad sectors – agriculture, products & services and government. Empirical work using the MSIASM model yields valuable insights regarding the constraints associated with sectoral shifts and with the overall expansion of productive and consumptive activities.

Work on activity analysis (Koopmans 1951) focuses more on the inside of the production process. Similar to Input-Output analysis it represents production as a network of interrelated operations, processes and production stages that are carried out by a distinct set of production factors in specific operational and organizational patterns (Georgescu-Roegen 1969, 1989, Scazzieri 1993, Hackman and Leachman 1989). Activity analysis offers considerable detail of the production process itself, but it can also provide insights into the demands different production processes and organizational patterns impose on various environmental and social context factors. Social impact, for example, can be described as the different demands on restorative and reproductive time and on the required preparation (education and training) associated with different processing patterns.

Building on the work of Ricardo, Sraffa (1960) developed a model of production that arrives at an invariant measure of value. His work also inspired the Cambridge Economists' critique of neoclassical capital theory (see for example Joan Robinson 1969, 1974; for an extension of Sraffa's work see Roncaglia 1991 and Kurz 2006). Kalecki's work too built on the work of classical economists by developing a cost-of-production based theory of price as opposed to the demand-based theory of price that characterizes neoclassical economic theory (1969).

One of the most comprehensive representations of a system of production that takes both the production process and its contexts into account is Georgescu-Roegen's flow-fund model (1984). It distinguishes between factors and processes associated with stocks/flows and funds/services. A stock is a type of productive input that may be used at any given rate, akin to the MSIASM model's Total Exosomatic Energy throughput. A fund is a type of productive input that can be used only at a certain rate. While "the decumulation of a stock may, conceivably, take place in one single instant" or over time, the decumulation of funds is time dependent and may be used only at a given rate determined "... by the physical structure of the fund." (Georgescu- Roegen 1971, p.226-27). For example, seven tons of coal can be burned in one day or one ton can be burned every day for seven days; yet one laborer can only dig one ditch a day for a week, but cannot dig seven ditches in one day. A stock is capable of producing a flow at any desired rate, but a fund is capable of producing a service only at a given rate that is subject to the constraints of biological time and physical context. These constraints also find expression in social and environmental contexts that provide rest, restoration, and reproduction.

The stock/flow and fund/services distinction then differentiates between viable and feasible production. Viable production is characterized by processes that maintain the corresponding material structures, that support the resourcing and sink functions of production (outside); and it is characterized by a production process that maintains the factors that transform inputs (internal). Our current economy does neither. It relies on stocks of fossil fuel that cannot be maintained; and it depends on funds, the agents of production (transformation), that are over-utilized. The result, a reduced availability of flows and reduced processing capacity, invariably impairs future production.

While new technology may allow for the substitution of scarce stocks by abundantly available ones, the substitution process may increase the demand imposed on fund factors. The increased pressures on labor associated with ever growing expectations of work hours, speed, and skill may serve as an illustration. As pressures on labor inputs (funds) increase, the resulting burden is shifted and translates into higher requirements of care and restoration provided by households, and into higher demands on buffer and absorptive capacities provided by ecosystems. All production depends on the ability to sustain the fund factors that facilitate the processing of flows -- that is it depends on maintaining the physical, intellectual and creative services provided by labor funds and the processing services provided by manufactured capital inputs. As funds are utilized to a different degree or in different combinations, their capacity to generate services may be increasingly challenged. Every production process may thus be feasible, but not every process is viable since "…a technology is viable if and only if it maintains the corresponding material structure and necessarily the human species." (1984, p.29) Georgescu-Roegen writes:

> " In every enterprise, in every household, a substantial amount of labor-time and material are steadily devoted to keeping the buildings, the machines, the durable goods, in a useful, workable state.... Undoubtedly, when a worker leaves a process, he is a tired individual. But when the same individual returns to work next day he is again a rested worker after being restored in an adjacent household." (Georgescu-Roegen, 1984. p. 24).

The proper consideration of social and environmental context factors that sustain economic production has macro-economic implications as well. It points to the inadequacy of aggregate economic output (GDP) as a guide for economic policy. Various efforts have been made to develop an alternative measure that challenges the shortcut assumption that welfare equals utility equals GDP. These include Daly/Cobb' s Index of Sustainable Economic Welfare (ISEW) and its refinement in the Genuine Progress Indicator (GPI). Both measures take personal consumption as their starting point and adjust for (1) defensive expenditures necessary to repair damaged social and environmental systems features, (2) non-renewable energy resources borrowed from future generations, and (3) shifts in the functions provided in households and civil society to the market economy (Daly and Cobb 1989, Cobb et al 1995).[3]

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[3] Data for the United States indicates a parallel development of GDP per capita and a 'corrected' General Progress Indicator (GPI) between 1950 and 1970. Since the 1970s GDP per capita and GPI per capita show dramatic differences. Between 1973 and 1994, for example, per capita GDP increased by 73 percent while per capita GPI fell by 45%. This indicates a growing disparity

Other measures build on the so-called 'needs theory' of Quality of Life research that traces its roots back to Maslow' s theory of human motivation (1970). It suggests at least four generalizable categories of human material (economic) and non-material (cultural) needs – physical needs, safety needs, affection and belonging needs, and esteem needs. As each successive category of needs is satisfied, the quality of life increases. Similarly, multi-criteria measures like the UN Sustainable Development Index use distinct social, economic and environmental indicators in their respective (non-commensurate) dimensions to obtain information about the impact of different scenarios and levels of economic activity. This approach has also been applied to the analysis of regional economic activity and its impact (see for example O' Hara and Vazquez 2006).

What these efforts to re-conceptualize production have in common is that they seek to paint a more accurate account for the complexities of economic production – including accounting for its impact on social and environmental context factors and resulting corrections in the value of output. What follows is a systematic conceptualization of production as an embedded process termed sustaining production. The concept builds chiefly on Georgescu-Roegen' s notion of viable production and argues that the short hand model of production that has so influenced our economic policies is insufficient and leaves out critically important components. The concept of sustaining production adds the missing pieces and identifies information gaps and accounting deficits that will require continued attention in order to improve decision-making.

Toward a Sustaining Production Theory

Georgescu-Roegen' s analytical framework of production and his distinction between feasible and viable technologies drew attention to the role of the invisible contributions provided outside the boundaries of the production process long before the sustainability debate was fully under way. Viable technologies imply that flows and funds will be sustained in the long run. Applying this condition to the buffering, assimilative, restorative, re-creative and reproductive processes provided in ecosystems, households and communities yields the characteristics of a sustaining production process. The term Sustaining Production implies more than sustainability defined as maintaining intergenerational welfare, the productivity of economic systems (Tisdell 1991), or capital stocks – including natural capital stocks (Costanza et.al. 1992). Instead, the term is more akin to Hueting's definition of sustainability as maintaining the regenerative capacity of the environment (Hueting 1989, Hueting et.al. 1992). Sustaining Production implies a network of processes that sustain the social, biological, ecological and physical context within which all production takes place. Only this sort of production is sustainable in the long term. In Georgescu-Roegen's language, the practical problem of sustainability is concerned with working out the tradeoffs between the stock-flow space and the fund-service space of the networks that characterize production processes.

Much of the sustainability discussion in ecological economics has focused on weak versus strong sustainability and on maintaining natural resource stocks to generate

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between aggregate consumption and the social and environmental costs associated with defensive expenditures, resource depletion and the loss of non-market service contributions.

sustainable levels of flows. An example is the definition of maximum sustainable yields of renewable resources. Some consideration has also been given to the quality of resource stocks and the underlying support functions that maintain them (Bishop 1987, Costanza et.al. 1991, Daly et.al.1991). The 'fund factors' of human labor power (L), manufactured capital (K), and Ricardian land (N) that ensure the sustained processing of input flows have received considerably less attention. An exception is the work of feminist economists that has focused on the productive and reproductive role of households and communities.

A sustaining production process that is defined in terms of its impact on social and environmental context funds and flows is depicted in figure 1. Each quadrant is a schematic representation of the processes associated with a systems component of the overall production process. The depiction does not claim to be comprehensive, but serves as a schematic summary of the concept of production as a context based process. Its graphical representation builds on economists' familiarity with the schematic description of a production function and illustrates expansions to this familiar concept that are needed to arrive at a sustaining production concept.

The first quadrant in figure 1 depicts the common formulation of production (output q) as a function of input flows of labor (l), capital (k) and natural resources (n) summarized as inputs i whereby q = f(i). The input vector (i) reflects the technology, management practices, labor skills and material and energy resources necessary to generate the production described.

The function underneath in the second quadrant of figure 1 depicts the emission function that corresponds to the production process described in the first quadrant whereby emission e is a function of input flows k, l and n or e=f(i). E describes the common conception of externalities. As technology changes, not only is the relationship between inputs and outputs altered, but the emissions generated change as well. In some cases technological change may reduce both input and output flows (waste), in other cases it may lead to different types of emissions but not necessarily to their overall reduction.

Quadrant three of figure 1 describes the processes (care, rest, assimilation, absorption, restoration, recreation etc.) that take place between the emission source and the social and environmental context to which the emissions are released. This processing capacity is a function of multifaceted criteria characterized by complex interactions in environmental, social and cultural contexts. The functional relationship between emissions and their impact depends on the ability of the environment to absorb, assimilate, buffer, restore and reproduce; and on the ability of human social systems to heal, support, care for, restore and reproduce. As fund factors deteriorate, the functional relationship between sustaining environmental and social functions (s) and emission levels e, with e=f(s), will result in the declining ability of environmental and social systems to ameliorate the effects of emissions, waste, physical exhaustion, emotional stress, mental ineffectiveness and so much more.

This then allows the formulation of a production process q as a function of sustaining services s in the forth quadrant of figure 1 where q=f(s). A process of output generation that qualifies as sustaining production will maintain or improve sustaining services (s). A process that will reduce or undermine sustaining services (s) is unsustainable and can in fact turn destructive. An unsustainable production process will

not be able to reach the same levels of output as a sustaining process without further investments in compensatory services. To meet the definitions of a sustaining production process the vector depicting sustaining services must at least be maintained, if not increased.

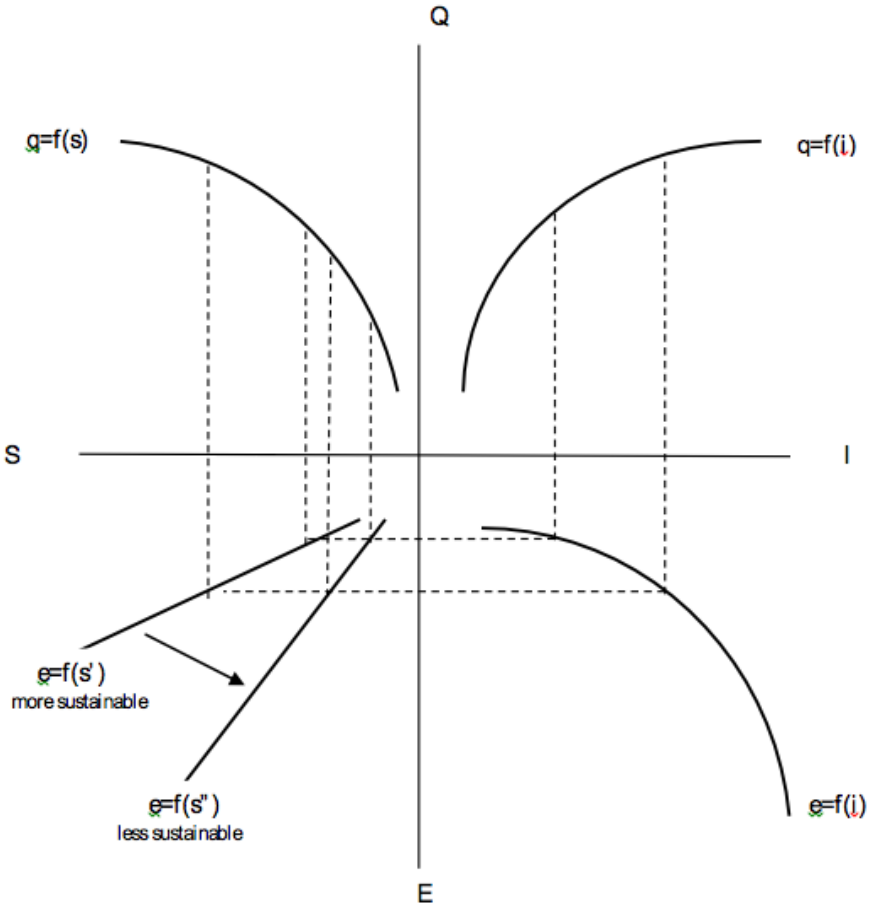

Figure 1: Sustaining Production Concept

It is important to recognize, however, that a sustaining production process as described in this crude graphical form must be understood in relationship to a whole integrated system and not simply in relationship to individual systems components. Groundwater quality, for example, is not simply a function of emission levels, but also of soil type, aquifer condition, precipitation patterns, and numerous other factors. And labor quality is not simply a function of education, but also of rest, care, recreation, support, social connections, meaning and so much more. Likewise, the concept of sustaining production must consider a wide range of diverse criteria, including region and culture specific ones. This then is one of the significant challenges the concept poses: it is possible to identify some generally applicable social and environmental context criteria that must be sustained almost regardless of time and place; yet others cannot be generalized, but carry instead the expressions of context and culture specific information associated with a specific place and time.

Defining natural resource funds and the functions necessary to maintain them is thus no easy task and will require much interdisciplinary dialogue. Yet it offers the

opportunity to re-think production processes and networks with an explicit aim toward maintaining and utilizing social and environmental funds and services rather than undermining them. This may include global environmental systems like maintaining the atmospheric gas balance; regional ones like providing genetic material for pest-resistant plants or utilizing soil filtration to support zero emission manufacturing parks; and local ones like the nutrient cycling necessary for food production or the absorptive and assimilative capacity of stream ecosystems to retain water quality (Westman 1977, Wilson 1989, Cairns and Niederlehner 1994, Munasinghe and Shearer 1995). And it also includes social systems of households, communities and institutional arrangements that are particularly important to maintaining labor flows and funds/services including those that maintain capital and natural resource funds. The assumption that labor is abundantly available neglects the fact that worker substitution through relocation or technology places significant demands on the support services provided outside of the production process. The impact of the recent economic downturn is a case in point. While unemployment levels remain high those in the workforce are expected to achieve ever-higher levels of productivity. Those excluded from the workplace suffer from the emotional and financial pressures associated with under- and unemployment. Both the loss of job security and work related stress are thus demanding growing levels of physical and emotional care and support. The accompanying erosion of leisure time also reduces participation in civic society and participation in social and democratic institutions. And added pressure will invariably result from the growing discrepancy between rich and poor, the skilled and the unskilled, the sought after and the unwanted.

The concept of sustaining production offers an extension of Georgescu-Roegen' s flow- fund structure matrix that makes visible the costly difference between feasible and viable production (1971 and 1981). As Georgescu-Roegen pointed out, while this kind of analysis is necessary to escape the "save-invest-grow cycle… one should not overlook the gigantic problem of applying the model to actual situations." (Georgescu-Roegen 1981 p. 60). Table 1 offers a starting point for identifying environmental and social funds and flows that must be maintained to meet the conditions of sustaining production. Not maintaining them translates into real costs associated with social unrest, floods, droughts, wildfires, food production disruptions, and other (often unpredictable) effects of changed context conditions.

Table 1: Indicators of sustaining functions

	Social sustaining functions	**Environmental sustaining functions**
Sustaining Flows	Work force replacement Work force development and training Capital-embedded labor Capital-embedded technology (skill, know-how) Land-embedded labor Land-embedded technology (skill, know-how)	Maximum sustainable resource yields Resource conservation Buffer capacities Adsorptive capacities Soil fertility Freshwater replacement Species reproduction
Sustaining Funds	Education Health care	Capital-embedded natural resources Ecosystems health

	Rest Safety Shelter Social Interaction Support Meaning	Buffer capacities Adsorptive capacities Hydrological cycles Temperature buffering Reliability/Predictability Stabilization

Much inter-, multi-, and cross-disciplinary work is needed to further define and operationalize particularly the third quadrant of the model. Much analytical work also remains to define the general versus context specific criteria that describe the web of sustaining services that must be maintained in order to move from mere output generation to sustaining production. The concept of Sustaining Production then offers a visual image of the work ahead. The long time neglect of this work, and the true costs and accounting needs associated with it, is no longer viable. Gus Speth summarizes its consequences as follows:

> " … key features of the system work together to produce a reality that is highly destructive. An unquestioning society-wide commitment to economic growth at almost any cost; powerful corporate interests whose overriding objective is to grow by generating profit, including profit from avoiding the environmental costs they create and from replicating technologies designed with little regard for the environment; markets that systematically fail to recognize environmental costs unless corrected by government; government that is subservient to corporate interests and the growth imperative; rampant consumerism spurred by an addiction to novelty and by sophisticated advertising; economic activity now so large in scale that its impacts alter the fundamental biophysical operations of the planet – all combine to deliver an every-growing world economy that is undermining the ability of the planet to sustain life." (2010).

A New Policy Agenda

The concept of sustaining production has significant policy implications. Markets alone are not able to set the signals necessary to communicate the costs associated with maintaining the social and environmental input flows and fund factors that assure a sustaining production process. The fact that deliberate attention must be paid to the context of production runs counter to the prevailing economic policy agenda – to maintain growth in aggregate output (GDP) at any cost to meet consumer needs/wants. Even in light of the current economic crisis with its stubbornly high unemployment rates, with its collapsed real estate market that has eliminated the bulk of household assets, with shrinking credit scores for millions of US consumers that defy the logic of lower interest rates = increased borrowing = increased consumption; and even in light of mounting evidence of global environmental disruption with massive water management problems, storm events, and vulnerable food systems; the message in Washington continues to be: stimulate consumption, stimulate growth!

Even if one corrected the costs of input streams and transformation services used

in the production process to reflect their social and environmental costs (however incomplete), it is doubtful that this would result in a fundamental change of the economic policy message. What is needed is a new message that drastically shifts attention from maintaining output generation to maintaining the sustaining activities on which all current and future production depends. What follows is a brief discussion of four aspects of this change in economic policy – communication, participation, regulation and incentives. All four aspects would warrant a chapter of their own. They are offered here merely as an invitation for further discussion and much needed action.

1. Communication

One of the big success stories of US economic policy is how effectively it has communicated its message of "more is better". This message, which is fueled by the underlying valuation biases of NWE discussed earlier in this chapter, holds that increased per capita output in final goods and services produced and resultant growth in per-capita income are the very drivers of social welfare and economic health. If consumption grows, so does production, so do jobs, so does income, so does well-being, and the 'more-is-better' equation is complete. US consumers have taken their responsibility as drivers of economic health quite seriously as evidenced in negative savings rates and growing debt. While there has been a slight reversal in savings rates during the recent recession the underlying message remains firm: consumption is good no matter what.

The expected increase in well-being, however, has not been as forthcoming. In fact, recent research shows a picture of increased dissatisfaction, insecurity and depression. Gus Speth quotes psychologist David Myers in describing the American paradox of " …big houses and broken homes, high incomes and low morals, secured rights and diminishing civility." (2010). This should not be too surprising. Quality of life research has long shown that material needs make up only a portion of what constitutes well-being. Economic development must therefore address more than materials needs. It must also address non-material needs such as security, social connection, self-esteem, recreation and other factors that constitute a part of human well-being (Sen 1992, Nussbaum). Rather than keeping track of the single indicator of GDP the real story of economic well-being must therefore also include information about multiple other factors. Building on earlier work in economic development I have termed these key areas of well-being the ' five pillars of economic development' to bring into focus the need for development strategies that improve (1) education, (2) health care, (3) social and cultural amenities, (4) environmental quality, and (5) access to communication and transportation infrastructure (O' Hara and Vazquez 2006). Addressing these five areas offers a positive starting point for improving the quality of life while also improving the conditions for economic development itself.

Other recent work also addresses the need for positive alternatives that can help illustrate solutions rather than pointing to problems (McKibben 2010, 2008, Schor 2010). It is unclear, however, how much of this work has penetrated popular awareness and much seems to be reaching those who are already sensitized. One possible way of structuring communication efforts may be to focus on three circles of sustaining production: in order to be productive and generate the goods and services we need and want in the long term, we must sustain self/individuals, other/communities and the environment/nature (O' Hara 1998b). Framing these three categories in terms of personal

stories that offer easy connecting points may be one possible starting point for new communication strategies.

Calculations of the Genuine Progress Indicator and the Human Development Index offer similar alternatives and many countries already publish a Social Progress Report that captures broader measures of the quality of life. These examples illustrate that it is not the lack of information, but the lack of an effective communication strategy that seems to be at issue. GDP is one convenient number that enjoys universal brand recognition. More complex indicators are less convenient, less familiar, and more difficult to track. Developing an effective communication strategy that highlights the value proposition of an economy built on the principles of sustaining production, and that presents the concept in easily digestible form is a critically important element of a new economic policy agenda. This communication strategy must succeed in connecting the dots between output generation and the social and environmental context factors that undergird it. This is not an easy story to tell. Big catastrophes like large scale deforestation, the oil spill in the Gulf of Mexico, mass foreclosures and unemployment are not easily communicated no matter how much one would expect them to galvanize public attention. Recent research suggests that individual stories are more effective in generating sympathy, support and a sense of urgency (Slovic 2010). Large-scale disasters tend to create a sense of paralysis and detachment. Translating them into stories of individuals, families and neighborhoods appears to be far more effective.

Yet neither economists nor policy makers can resolve the critically important need to identify an effective narrative that redefines the economic policy agenda. The best communication strategists must be put to work to alter the public discourse from growing output to sustaining production. How formidable the communication challenge is can be seen in the recent US health care debate where close to half of the general public still feel uninformed or misinformed even after months of debate. Developing an effective communication strategy that shifts the debate then will require nothing less than the political will to launch a sustained, broad based effort to set the story right. It is not likely that those who have benefitted most from the compliance of US consumers in the growth story will want to alter the narrative. It is therefore all the more important that those who remain outside of the special-interest network are represented in a broad-based education and communication strategy that will change the tremendously successful more-is-better narrative.

Beyond changing the focus from any kind of output to the kind of output that sustains the social and environmental context of output generation, the sustaining production narrative also raises broader issues of obligation versus rights. These are expressed in the moral debate of Kantian and Rawlsian versus Communitarian values (for example Macintyre) that raises fundamental questions about present generations obligation to future generations and intergenerational notions of welfare and justice (see for example Dryzek et al 2011, Howarth 1992, Padilla 2002).

2. Participation

A critically important question in conceptualizing a sustaining production process is who gives expression to the sustaining functions that form the social and environmental context that undergirds the flow and fund factors of production. Commonly, professional experts have been consulted to define relevant social and

environmental indicators and critical quality thresholds. Relevant fields of expertise cover a wide range including microbiology, ecology, hydrology, public health, agricultural science, ecological economics, neuroscience, psychology, sociology and cultural studies. It has been less common to consult those with context specific local knowledge or those whose knowledge systems have been marginalized (Clement Tisdell 1995, O' Hara 1999).

As feminist scholars have pointed out, the reliance on credentialed experts and their underlying assumptions ignores the fact that different academic fields and knowledge systems bring distinct biases to the process of selecting indicators of social and environmental context systems and their health (Harding 1986, Ferber and Nelson 1993, O' Hara 1995, 1996, 1998a). Such biases are typically expressed in quantitative over qualitative information, universalizable over context specific, reducible over complex, and specialized over variable indicators. Since the perspective of credentialed experts and agents tend to dominate, valuable social and environmental dimensions of long-term sustainability may be ignored (Dryzek 1987, 1990).

Yet admitting marginalized and less familiar perspectives to the debate is no easy task. The burdens associated with the erosion of social and environmental sustaining functions are not evenly distributed. The poor, those without access to education, the sick who have no access to proper care, those with limited access to communication and those saddled disproportionately with the burdens of a deteriorating environment (no air conditioning, no portable water, no refrigeration) have less opportunity and less power than the wealthy, well-educated and well-connected to bring their life-world (Habermas' term Lebenswelt) to bear.

An added challenge is that expressions of environmental context criteria and their quality demand that non-human perspectives are considered as well. This calls for new approaches and sensibilities in the assessment process that bring those areas that are in critical need of support to the fore. Successful efforts will require leveling the playing field and bridging persistent information and communication gaps so that those whose voices have gone unheard can become accepted partners in the process of defining critical social and environmental sustaining functions.

To add to the challenge, informed participation in the public sphere is in jeopardy irrespective of existing biases and exclusions. As pressures mount to move services from households, volunteer organizations and the subsistence sector to the market economy, and as the demands of the market economy grow, the time and energy available for civic engagement continues to decline. This dilemma has been well documented. A recent bright spot has been the engagement of younger US voters in the 2008 presidential election. For the majority of them access to political participation happened via the Internet and its array of social networks, blogs and tweets. Sustaining their engagement and extending it to an issue focus, however, has proven challenging and it is not self-evident what channels for informed public participation and engagement exist and how expressions of informed public discourse can reach decision makers.

New social media certainly play a role in expanding and redefining participation. Yet serious consideration must also be given to such traditional institutions of public discourse as the Vermont town meetings and face-to-face hearings. One of the dangers of virtual participation is that it attracts networks of like-minded advocates, including niche groups. The anonymity of the medium has also been shown to lower barriers of civility

resulting in unproductive name-calling and dismissive attitudes toward opposing opinions. This is a far cry from institutionalizing participation in an informed public discourse. Behavioral research confirms the benefits of face-to-face interaction in decision-making. As I have argued previously, what is needed is a significant expansion of participation in a broad based discourse that makes transparent the relevance of sustaining social and environmental funds and flows at the local, regional and national level (O' Hara 1996, 1997, 1999). This kind of discourse is also indispensible to expanding our knowledge about the impact of social and environmental services on economic production and innovations that improve viable options of sustaining production alternatives. Context based knowledge, informed by the diverse life worlds of people and bioregions, is indispensible to a successful application of the concept of sustaining production in concrete situations and to operationalizing the concept on a broad scale. Its flipside, the continued lack of broad based discourse and exclusion of diverse perspectives, leads to the continued loss of socio-diversity defined as " …the diverse ways of social and economic arrangements by which peoples have organized their societies including the underlying assumptions, goals, values and social behaviors guiding these economic arrangements and processes" (O' Hara 1995 pg.32). The growing homogeneity of social and economic institutions around the globe should alarm us as much as the loss of biodiversity. Preserving socio-diversity (and possibly reversing its loss) may in turn yield invaluable information, restorative capacity, resilience and innovation potential.

3. Regulations

The effectiveness of markets as allocation mechanisms notwithstanding, their usefulness is limited when it come to operationalizing the concept of sustaining production (see for example Bromley 2009, 1992). Regulations are therefore an indispensible element of the new policy agenda of sustaining production. Regulations are also firmly embedded in current economic policy, albeit their main role is to protect the unimpeded economic growth agenda. This is despite significant differences between those policies that view the role of regulations as providing social and environmental protection and those that view it as protecting the market from interference. The latter is especially prevalent in the United States and its result is an almost unequivocal suspicion of regulatory policies and the role of government in general. Overcoming the resistance to regulations then is critical to a broader acceptance of policies that protect the social and environmental context that ensures the long-term viability of production. The question thus becomes how can regulatory policies be framed more effectively?

Two basic views offer themselves: (1) regulation can be viewed as a purely economic policy tool, and (2) it can be viewed as a tool to achieve broader ethical frameworks. This latter view stands in the tradition of the father of modern market economics: Adam Smith. Smith viewed the invisible hand of the market as working within an ethical framework of compassion that he saw as inextricably rooted in his Calvinist tradition. Smith argued that it is only within this ethical framework and constrained by its imperatives of compassion for ones fellow human beings that the invisible hand of the market brings order to the chaos of individual, self-interested pursuits of individuals and leads to social welfare. By abdicating to the market the responsibility of setting an ethical framework the framework itself is reduced to the

minimalist norms of market rationality (Pareto Optimality) without any guarantee that accepted societal norms and objectives are achieved. The history of US social and environmental policy is evidence of the fact that ethically motivated goals like the protection of children, the elderly, minority populations, air and water quality and endangered species are not achieved without explicit action; and neither are the values of social justice, the protection of natural beauty of the rights of future generations. These goals must be expressly stated in regulatory targets that are motivated by ethical norms that call for the protection of that which we value and of those who cannot protect themselves.

Alternatively, the protection of social and environmental sustaining functions can be viewed as motivated by a purely economic policy agenda. As the pursuit of economic growth undermines the quality and long-term availability of social and environmental services the economic, social and environmental costs associated with their loss become increasingly burdensome. Deteriorating infrastructure, declining civic engagement, the neglect of children and youth, lower groundwater tables, loss of fish and wildlife and the pervasiveness of invasive pests all have real economic costs. The aim of effective economic policies must therefor be to correct the resulting misallocation of resources in order to ensure long-term economic production.

While this may seem like a pretty straightforward argument for regulatory policies that enforce enlightened economic interests, one of the challenges is that social and environmental costs are frequently displaced over space and time. Effective regulations must therefore be foresighted and anticipate the losses and associated costs of exhausted and overburdened context systems even if they are halfway around the globe or ten years into the future. The history of the commons with its long list of examples of free riding and displaced social and environmental costs is not encouraging in this regard. Much has been written about the contradictory aims of short-term electoral goals and long-term sustainability goals. Yet as the costs of deteriorating social and environmental systems become more ubiquitous, support for regulatory policies that assume responsibility for improving the global commons may improve.

A change in public attitudes toward regulations, however, will require more than growing evidence. It will also require significant efforts in communication and education to raise public awareness of the role of regulatory policies and the limitations of free markets despite their significant allocative strengths. A growing number of studies indicate that there may be support for a reformed regulatory agenda. 81 percent of Americans now indicate that the country is too focused on shopping and spending; 83 percent state that society is not focused on the right priorities; and 88 percent state that American society is too materialistic (New American Dream, 2004). These numbers indicate that there may be a viable basis for reframing regulatory policy as a strategy for advancing long held values of relationship wealth over material wealth and giving over getting. Regulatory policy as a strategy for a return to basic values may thus offer a more promising approach than the enlightened economic policy approach that relies heavily on support for an intergenerational ethic.

Effective regulatory policies then will have to rely as much on scientific information as on information about shared values and norms. In fact, the concept of sustaining production inevitably points to the fact that the two are linked. As Robert Frank has so eloquently argued, the pursuit of individual competition and selection of the

fittest may in fact lead to a development path that results in significant disadvantages for the group as a whole and a departure from shared goals (Frank 2011). Similarly, the lessons we have learned from systems behaviors suggest that complex, nested systems defy our notions of analysis through compartmentalization and optimization based on individual aims. They point instead to multiple layers of connectedness even as systems success measures, scales and timeframes may vary. To sustain production in the long term then, regulatory policies must focus on the whole and dare not neglect the social, cultural, biological, ecological and spatial context systems that undergird production itself. Ignoring context turns out to be not only a violation of norms such as responsibility for the common good and future generations; it is simply poor allocation that burdens even those who benefit from free-riding in the short term.

4. Incentives

The notion of taxing bads and incentivizing goods has long been an integral part of economic policy. Incentives are a tool for making the market work for rather than against sustaining social and environmental context systems. Regrettably, public debate in the US on the role of energy taxes or carbon taxes has been stuck for some time. Both appear to be politically unfeasible. This is despite the undeniable effectiveness of carbon taxes in increasing energy efficiency and reducing carbon emissions. The same resistance is evident when it comes to other strategies to tax bads like the use of non-renewable materials or excessive executive salaries that amplify social divides. And there may be some inadvertent upside to this a priori resistance to taxes. Behavioral research suggests that incentives that penalize undesirable outcomes are not equal to incentives that encourage desirable outcomes. This does in no way imply that one should abandon disincentives for bads. In fact, carbon taxes may be an indispensible part of a policy-mix that signals the real costs of production. Yet differentiated strategies that incentivize the support of sustaining functions are also an important part of the mix and both strategies will have to be employed.

Successful incentive strategies may be found in more differentiated measures that support innovative models of sustainable communities, local living economies and community owned businesses (see for example McKibben 2008, Schor 2010). Such incentives will be locally and regionally focused, support human scale production, and incentivize growth of those activities that protect or increase the health and productivity of social and environmental context factors. This may include economic and non-economic incentives for creating jobs that earn a living wage; for locally oriented businesses; for businesses whose salary structures do not exceed a ratio of 1:25 between non-exempt workers and CEO salaries; for providing improved access to health care; for improved access to education and training; for relevant research that improves the living conditions of local communities and regions; for improved safety; for expanding citizen participation in planning and decision making; for increased social and ecological diversity; and incentives for improving the communication infrastructure in remote areas. These kinds of incentives encourage qualitative growth rather than the un-reflected quantitative growth of aggregate output. Incentives can range from taxes and fees to tax breaks and rewards to citizen salary models and non-economic incentives.

Re-envisioning incentive policies to support the implementation of a sustaining production concept may start with a visioning process that develops scenarios of

economic activity that improve local and regional living conditions (O'Hara and Vazquez 2006). Broad based participation in developing such scenarios will be essential. It forms the basis for defining what the new goals and objectives are and what incentives can be most productively employed to achieve them. An indispensible element of the policy agenda must therefore be incentives for public space (virtual or real), institutional arrangements and communication channels that support informed ethical discourse, information sharing, and consensus building. Such public space is defined as a communication space that engages a broad range of stakeholders who act as participants in an ethical discourse process and not as advocates of pre-formed agendas (O' Hara 1996, 2001). This kind of communication space can make visible the essential contextual details of history, culture and social groups that form the basis for a change agenda that can bridge traditional divides.

And there are hopeful signs of new community based alliances that can point the way to a successful transition from policies that are purely growth oriented to those that support sustaining services. It is these new formations of viable alternatives that effective incentive policies must first and foremost seek to strengthen. They may include:

- Regional and local economy alternatives that strengthen the five pillars of economic development (education, health, social amenities, environment, communication)
- Models of social and environmental entrepreneurship
- Free knowledge transfer between communities and regions both nationally and internationally
- Merging social and environmental agendas across social institutions and movements (incl. religious, non-governmental, educational, municipal…)

Incentives then can be an effective tool to jump-start a process of rethinking, re-envisioning and realigning actions. At the same time, caution is in order. There is a rich literature of research results that raise questions about the effectiveness of purely economic incentives. As has been suggested earlier in this chapter, there is an important place for civic virtue and for doing the right thing. Yet the growing urgency of addressing the continued erosion of sustaining social and environmental may require a multi-pronged approach of moral suasion, incentives and regulatory strategies.

Conclusions

Production has received relatively limited attention in new economic welfare theory, which has been chiefly concerned with the demand side of the economic model. Despite this limited theoretical attention, aggregate production has been the driver of economic policy as nations around the world pursue continued, if controlled, growth in GDP (final goods and service produced) or GDP per capita. The concept of production that underlies this economic growth model is rather simplistic. It views output as a function of inputs without consideration or concern for the social and environmental context that first makes the flow of inputs or their transformation into output possible.

In contrast, the concept of sustaining production recognizes the importance of social and environmental context factors. It acknowledges that their loss poses real economic costs and even jeopardizes production itself. Since their substitutability is

limited, production itself cannot be sustained as social and environmental context factors are degraded or lost altogether. A graphical representation of the concept of sustaining production offers a more complete picture of the production process and its impact and illustrates that the dominant view of production is woefully incomplete. This dominant view renders invisible the very sustaining services that maintain input flows, receive output flows, and sustain the fund factors necessary to process and transform input and output flows.

The sustaining services that maintain funds and flows take place in households, communities, ecosystems and biophysical context systems that have been relegated to the periphery of the production process. A sustaining production process is one that shifts attention away from the sole focus on output generation and to the context of production and the production process itself. The model of production as a function of inputs (q=f(i)) is expanded to include (1) emissions generated in the process of input use and transformation (e=f(i)) and (2) the buffering, absorptive, restorative and reproductive processes that ameliorate or exacerbate the impact of emissions and waste (e=f(s)) and arrives at the formulation of production as a function of these absorptive and restorative sustaining services (q=f(s)).

Operationalizing the concept of sustaining production will require much definitional work to expand our understanding of the specifics of the underlying sustaining processes that keep production viable in the long run. Yet while further definitional work is important the realization of past neglects needs no further proof. The concept of aggregate output that has so shaped our economic policy agenda is inadequate and overly simplistic. Given the far greater complexity of the concept of sustaining production, what is needed is an immediate shift in economic policy that reframes the story of economic production and acknowledges the need to explicitly protect the social and environmental context functions that first make economic production possible.

Four elements of this new economic policy agenda are briefly discussed: communication, participation, regulation and incentives. All four elements stress the need for political will. At the top of the list of this new economic policy agenda is the need to reframe the exceedingly successful message that higher GDP is better and that more aggregate output (in final goods and services) implies a higher quality of life. The fact that a growing segment of the American public has doubts about the long-standing equation of “more is better” offers a hopeful starting point.

Equally as important as a deliberate communication strategy is the need for a broad based, informed, public discourse that brings new perspectives to the process of assessing sustaining social and environmental context functions. Particularly valuable will be the contributions of those non-credentialed, local experts whose views have been marginalized or excluded, but who often carry the main burden of non-viable and unsustainable economic production. Such participation must meet the standards of a discursive ethics as opposed to the unproductive advocacy of entrenched positions and party lines. These two elements of the policy agenda (communication and participation) also play an important role in reframing regulatory and incentive based policies and in overcoming resistance to any form of government intervention that is so prevalent in the US.

Policies that can bring about a shift from a purely output based to a sustaining production concept do not stand in contrast to a strong economy. Instead, they are

indispensible to a strong economy and a high quality of life in the long run. As Adam Smith stated in his ‘ Moral Sentiment’ the invisible hand of the market can work only within a moral and ethical framework. It cannot provide that framework. The concept of sustaining production then requires more than scientific evidence. Its implementation requires the best science we can muster and the best values and ethical framework we know. Apart from its own merits, the concept of sustaining production may also clarify long neglected links between micro and macroeconomics, individual and social context, and humans and the world in which we live and whose fate is inextricably linked to ours.

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