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Economic Growth and Patterns of Sustainability

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Peter Bartelmus

1. Unveiling wealth and welfare

1.1 In search of happiness

Olet, aut non olet, that is the question: whether 'tis nobler in the mind to strive for income and wealth or to renounce it all. Well, maybe not all, but at least that part which does not contribute to happiness. This is the message we hear from philosophers, missionaries and post-utilitarian economists. Dancing around the golden cow through maximum consumption or national output, is self-deceiving: it does not add to personal happiness and might lead to social and environmental disaster.

Some disagree. According to Germany's *Spiegel*, money "*tut gut*" (gives pleasure). Proof is the enthusiastic discovery of the stock market by the middle class whose quest for financial gain reflects a "primeval sense" (*Urgefühl*) of human beings.¹ And who indeed is to judge primeval senses?

Theoretical investigations into the determinants of tastes and preferences stress the lure of attaining or maintaining desirable social status by more or less 'conspicuous consumption' (Veblen 1899).² Obtaining a sense of identity and security through income, wealth and consumption might be frowned upon by ideologues – but probably with little impact on general consumption behaviour. Add to this Scitovsky's (1976) reasoning that pleasure can be derived from a continuous flow of stimulating novelties and you have a strong argument for working with, rather than against, the monetary flows generated in the economy. UNDP's concept of human development seems to reflect this view, recognizing income "as one of the main means of expanding choices and well-being" (UNDP 1998, p. 14).

Acquiring riches may thus give pleasure and security, but does it make you happy? Recent happiness surveys, possibly reflecting a new quest for happiness,³ are to provide the answer. Notwithstanding doubtful methodologies and phrasing of questions ('are you very, fairly or not very happy?'), the general conclusions from these surveys seem to be (Kenny 1999):

- there is hardly any evidence that rich countries are happier than poor ones
- there is no evidence that economic growth (increase in GDP) generates additional happiness
- a possible exception are countries which have not met their basic ('animal') needs, i.e. those with per-capita income below \$1000 or \$8000 (depending on the country and study)
- relative wealth and income are significant determinants of happiness.

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1.2 Sustaining wealth and welfare – a matter of limits?

Happiness surveys draw attention to the possibility of misleading society, off the path towards national well-being, when using the established compass of the national accounts - but so are probably all attempts at quantifying national welfare (see section 2, below). Rather than trying to measure the non-measurable, a more realistic approach is to assess glaring symptoms of unhappiness, evaluate their significance and modify or complement the established compass accordingly. In other words, we have to look beyond the monetary veil at those things that wear the veil but whose production and consumption generate undesirable effects, and at those that do not wear it and are therefore excluded from the key indices of economic success - wealth, income, consumption. Three major flaws of these indices are readily identified:

- the consumption of products which do not give satisfaction or, worse, create serious health effects
- the generation of environmental deterioration by production and consumption, unaccounted for in conventional economic indicators
- the neglect of those goods, services and amenities which are produced and used outside the monetized economy.

Add to this further social, especially distributional, effects of current production and consumption patterns, and possible limitations of economic activity appear. Together, all these effects are signals of non-sustainability of economic growth and development. What are these limitations, and how serious are they?

Table 1 is to answer these questions. It confronts economic activities of production, consumption and generation of wealth with their economic, environmental and social impacts. The table further indicates possible measures of and limits to these impacts. Accordingly, economic, ecological and social sustainability can be distinguished. The nature and amount of socioeconomic and environmental impacts have been described in numerous publications. For instance, the most recent alert to global deterioration has been sounded by UNEP (1999), deploring the loss of water resources, tropical forests and fertile soils and, of course, continuing global warming; in addition UNDP's (1999) latest report blames globalization for marginalizing poor countries. Here, however, our focus is on the capacity of different indices to translate impacts into quantifiable determinants of (non)sustainability. Table 1 thus reveals the well-known, but unresolved, dichotomy between monetary and biophysical assessment of environmental and social pressures and effects.

Table 1. Sustainability: from limitations to limits*

<i>Categories of sustainability</i>	<i>Production</i>	<i>Final consumption</i>	<i>Generation of wealth (assets)</i>
Economic	<p>Impacts: supply of goods and services; capital consumption; omission of non-market products</p> <p>Measures: NDP; value added; capital formation; depreciation</p> <p>Limits: market conditions (price, cost, elasticity of supply and demand); productive capacities</p>	<p>Impacts: utility/well-being, crowding out of desirable consumption by ‘defensive’ expenditures</p> <p>Measures: household consumption per capita; GPI</p> <p>Limits: income, market conditions (price)</p>	<p>Impacts: sustainability of production (availability or capital); security and status (personal wealth)</p> <p>Measures: capital stock; net worth (assets and liabilities); savings; capital formation</p> <p>Limits: income and consumption; market conditions</p>
Ecological	<p>Impacts: natural resource depletion; environmental degradation (pollution); increase in environmental protection cost</p> <p>Measures: environmental cost; EDP, NCA; TMR, MIPS; defensive expenditures</p> <p>Limits: market conditions (environmental cost internalization); Factors 4/10 for dematerialization; environmental thresholds and standards</p>	<p>Impacts: natural resource depletion; environmental degradation (pollution); increase in environmental protection cost</p> <p>Measures: environmental cost (allocated to production); GPI; MIPS; defensive expenditures</p> <p>Limits: market conditions (environmental cost internalization); Factors 4/10; environmental standards; sufficiency standards</p>	<p>Impacts: natural asset discovery, depletion/destruction and degradation</p> <p>Measures: physical and monetary asset accounts (changes in stocks)</p> <p>Limits: sustainable yield; carrying capacity; resilience of natural systems</p>
Social (institutional)	<p>Impacts: (Un)employment; health; education; income distribution; corruption, crime; cost of social maintenance</p> <p>Measures: Unemployment rate; distribution measures; social indicators; HDI; defensive expenditures</p> <p>Limits: social norms; legislation</p>	<p>Impacts: overconsumption (consumerism, social exclusion); underconsumption (poverty); corruption, crime; cost of social maintenance</p> <p>Measures: GPI; social indicators (quality of life); consumption patterns; HDI</p> <p>Limits: basic human needs; social norms (ethical values)</p>	<p>Impacts: generation/erosion of human and social capital and temporal wealth; distribution of wealth</p> <p>Measures: value of social and human capital; time budgets; social indicators</p> <p>Limits: social norms (ethical values)</p>

*Acronyms: see text.

Monetary measures, especially those from ‘greened’ national accounts, make use of a sustainability criterion, already built into conventional indicators of income, production and capital formation. The United Nations’ (1993) System of integrated Environmental and Economic Accounting (SEEA) thus makes a cost allowance, not only for replacing depreciated produced capital but also depleted and degraded natural assets. Capital maintenance for continuing production and consumption, i.e. for economic growth, is the *economic sustainability* criterion. Costing natural capital consumption, i.e. the loss of natural resources and capacities to absorb waste and pollutants, is favoured by environmental economists. Adjusting conventional input, output, capital formation and wealth indicators avoids the setting of (normative) standards while achieving environment-economy integration in a systematic (accounting) fashion. Overall capital maintenance assumes weak sustainability, i.e. possible substitution of natural capital loss by other production factors - at least “at the margin”.⁴

Environmentalists reject this commodification of the environment. They see nature as an indivisible national or global heritage about which people hold personal beliefs and convictions, rather than preferences in terms of economic cost or benefit. Since, according to this view, the value of the environment cannot be expressed in money, biophysical indicators of sustainable development, carrying capacity of particular territories, or flows of materials through the economy are advanced.

Because of its relative simplicity, ease of aggregation and consistency with environmental accounting, material throughput has become a widely accepted measure of environmental pressure from production and consumption activities. Such pressure is the result of the physical laws of thermodynamics and needs to be assessed in physical terms. Material flow accounts (MFA) thus measure the use and movement of materials by means of the Total Material Requirement (TMR) and Material Input Per Service unit (MIPS) indices (Spangenberg *et al.* 1999). *Ecological sustainability* is captured with the claim that both indices should be at a level compatible with the long-term ecological equilibrium of the planet. Ecological equilibrium is then operationalized by applying the normative notion of equal environmental space⁵ for everybody to the overall use of materials and energy. The result is a sustainability standard which calls for the ‘dematerialization’ of economic activity by halving TMR while doubling wealth and welfare: the popular notion of Factor 4 (von Weizsäcker, Lovins and Lovins 1997). Under current production and consumption patterns, this is deemed to require a Factor-10 effort by industrialized countries within the next 50 years.⁶ Ecological sustainability is typically strong, demanding the full preservation of biophysical environmental assets to ensure continuing delivery of their vital services.

As indicated in Table 1, such normative standards and limits will also have to be set for - mainly physical - indicators of social and institutional effects of economic activity. In analogy to economic and ecological sustainability, *social sustainability* can be defined as the maintenance of human, social and institutional capital. Human capital represents the knowledge, skills and health of a population, affecting the productivity of labour. Except for losses of traditional knowledge by ‘modernized’

indigenous populations, there is hardly any ‘consumption’ of human capital, without re-production, i.e. non-sustainability.⁷

The problematique is different with social and institutional capital, representing the norms, rules and regulations necessary for social cohesion and orderly economic performance. Here, increases in distributional inequities – within and among countries and generations – and social ills represent losses of social capital. Such effects have been stressed in particular by those who believe that the time has come to enter the post-materialistic age: conspicuous consumption should now be replaced by environmentally and socially (non-competitive) sound consumption levels and patterns. Such attitudes would lead to the substitution of material wealth by non-material social capital of better communication and interaction and greater ‘temporal wealth’ (Scherhorn 1995).

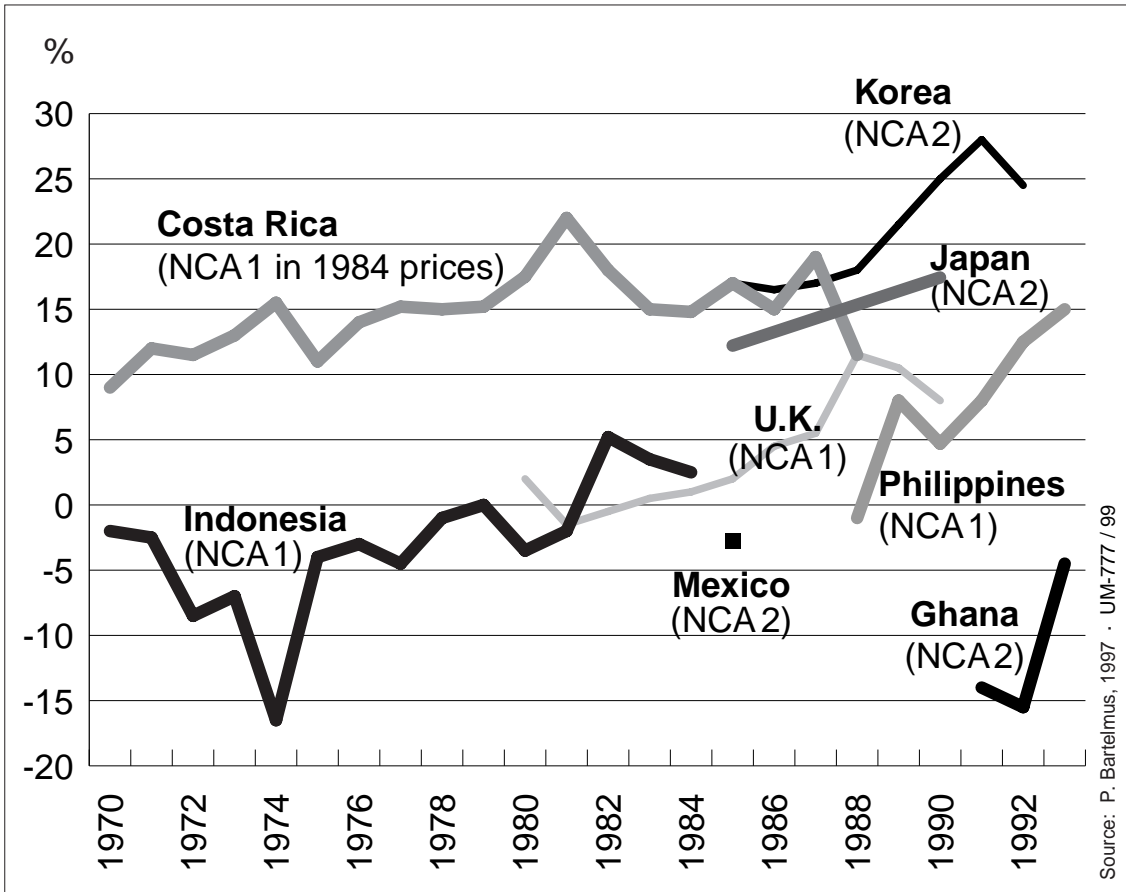
Clearly, non-material aspects of sustainability are difficult to measure. Moreover, they require the explicit setting of social values and norms which are usually drowned in political rhetorics and exigencies. The following focuses therefore on the assessment of economic and environmental sustainability, in terms of capital maintenance and violation of sustainability targets for dematerialization. Both notions refer in principle to the sustainability of economic growth. As discussed in section 4.1, below, the incorporation of non-economic objectives of a social, political and cultural nature aims at the sustainability of a broader concept of ‘development’.

2. Where are the limits? Meaning sustainability in growth and development.

Table 1 lists diverse physical and monetary indicators of and for sustainable growth and development. The results are confusing and frequently contradictory. Measures of natural wealth (World Bank 1997), genuine progress (Cobb, Halstead and Rowe 1995) or UNDP’s (annual) Human Development Index (HDI) suffer from a high-handed focus on ‘key’ concerns and indicators, controversial pricing of priceless values of health, leisure or cherished species, inconsistency with standard economic indicators, and arbitrary, usually equal, weighting of unequal issues such as life expectancy, literacy and GDP per capita as by the HDI. The purpose may indeed be more to cause a stir than to support decision making.

Owing to their systemic and systematic approach, MFA and SEEA appear to become international standards for environmental accounting and the assessment of sustainable growth and development.⁸ In line with their focus on biophysical and monetary data, they reflect respectively the above-described notions of ecological and economic sustainability, i.e. dematerialization and capital maintenance.

Figure 1 shows Net Capital Accumulation (NCA), accounting for the long-term loss of natural resources and environmental degradation, in per cent of Net Domestic Product (NDP). Indonesia, Ghana and Mexico (as far as a



Source: P. Bartelmus, 1997 · UM-777 / 99

NCA 1: net capital accumulation covering natural resource depletion costs only

NCA 2: covers depletion and degradation costs

Figure 1: Net capital accumulation in per cent of NDP

one-year result can tell) exhibit non-sustainable patterns of disinvestment. The performance of all other countries seems to be sustainable, at least for the periods covered, and in terms of overall, produced and natural, capital maintenance. As already mentioned, past overall capital maintenance or increase represent weak sustainability which hides possible complementarities in the future use of environmental assets.

Physical indices of material intensity can be seen as proxy measures of pressure on the environment, resulting from throughput of materials through the economy. Figure 2 reveals a trend of delinkage reflecting a bundled responsibility importing sustainability and exploiting national environmental assets in terms of TMR per GDP which includes hidden flows of 'ecological rucksacks'.⁹ of environmental pressure from growth for selected industrialized nations. Relative environmental pressure is measured. Note, however, that declining trends in these indices may hide increasing - absolute - material throughput in connection with increasing GDP, i.e. increasing pressure on environmental capacities.

The above statistics do not unequivocally confirm the sustainability or non-sustainability of economic growth and development. The reasons are limitations in scope and coverage and controversial valuations and weighting of environmental impacts. Pricing the priceless in environmental accounts, i.e. the monetary valuation of environmental assets and changes therein, has to resort to simplifying assumptions for using a 'net price' for natural resources and costing - in lieu of controversial damage valuations - the maintenance of waste absorption capacities. MFA attempt to circumvent the valuation problem by weighting material flows with their 'natural' unit, weight. It is recognized that such weighting is 'unspecific' in its focus on overall environmental pressure and its neglect of different scarcities in material use and differing severity of environmental impacts. The justification is that applying a precautionary approach is the only way to deal with potentially disastrous and largely unknown environmental effects.¹⁰

Nonetheless, these first assessments of material inputs and environmental costs do convey a feeling of considerable risk in pursuing current production and consumption patterns. This might hold for both industrialized and developing countries, especially if the latter emulate the industrialization process of the former.

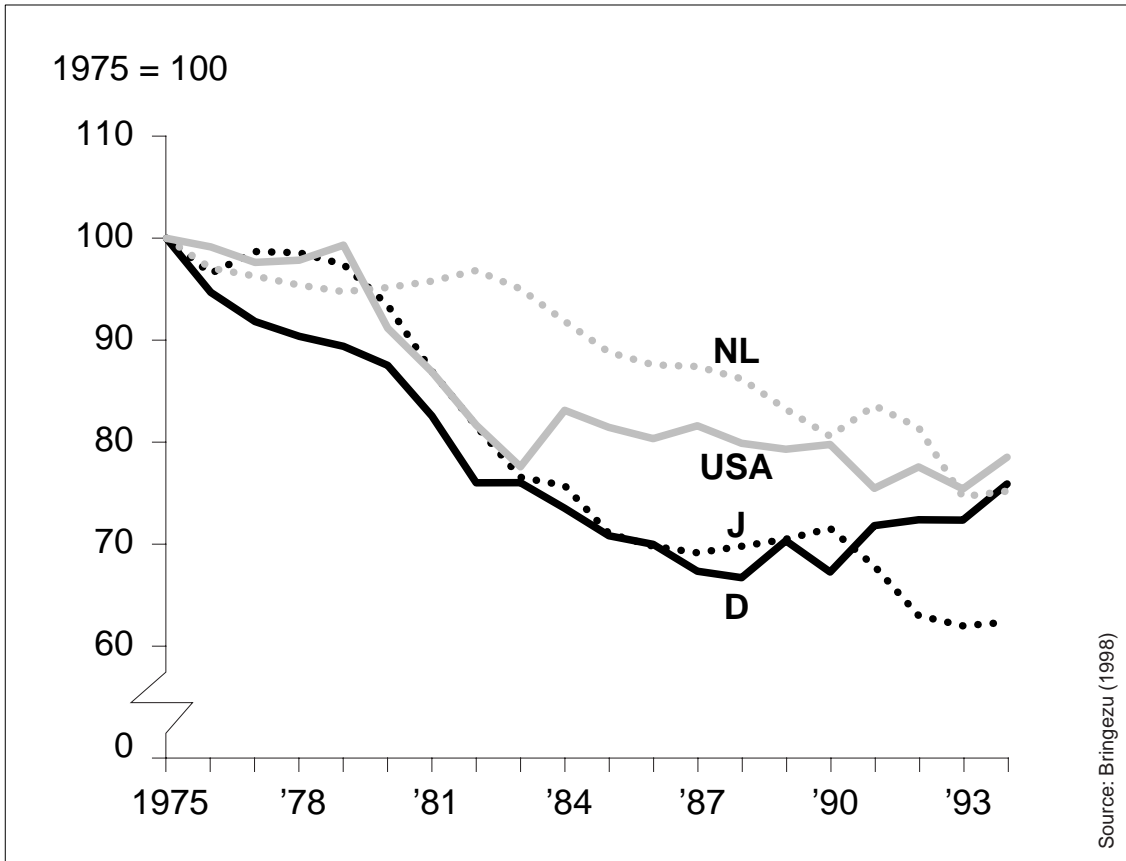


Figure 2: Overall Material Intensity (TMR / GDP) Index

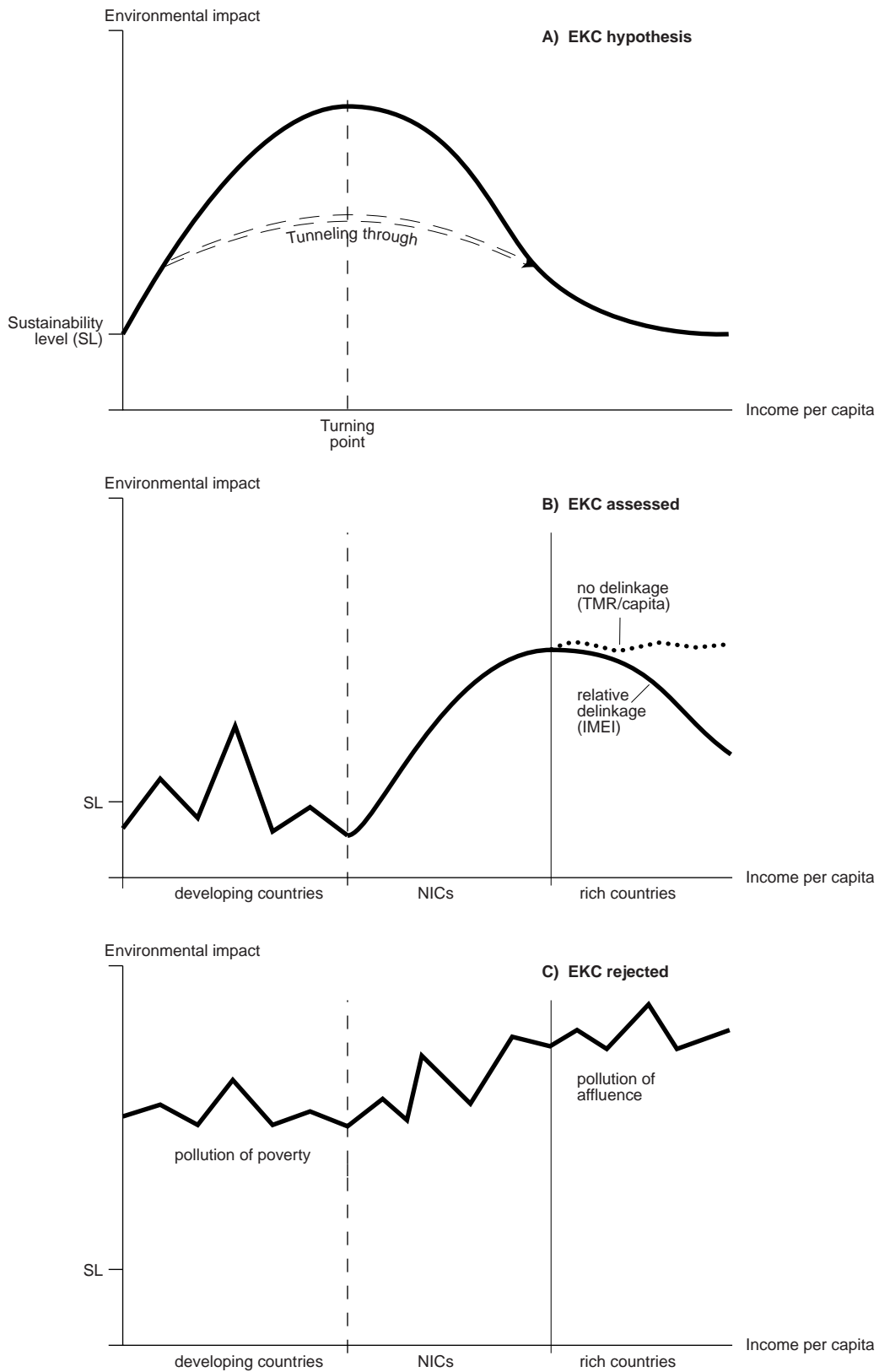


Figure 3: Environmental Kuznets Curve (EKC) – confirmed or rejected ?

3. From paradigm to policy

As shown above, non-sustainabilities of economic activity present themselves in operational terms as the limited availability of environmental assets and their services. These limits can and have been assessed by costing asset scarcity in terms of capital consumption and by comparing dematerialization with long-term resource availability. In principle, there are three options in addressing the limits:

- ignoring the limits – muddling through
- pushing the limits – searching for ecoefficiency
- complying with the limits – attaining sufficiency.

3.1 Ignoring the limits: muddling through

Many liberal economists seem to believe that muddling through, i.e. just reacting to the worst environmental symptoms when they occur, is preferable to heavy-handed governmental interference with individual decision making. As recently argued by the stalwart of market liberalism, *The Economist* (of 11 September 1999, p. 16), “high-minded principle and arrogance“ are the reasons for government and pressure groups to frequently impose their visions – only to be abandoned later as mistaken. Experimentation by markets, a particular form of muddling through, is seen as “a humbler way of going about things than by following the conceited blueprints of politicians, the hubris of monopolistic businessmen, or the arrogance of scientists“.

In the environmental field, an intriguing attempt at justifying such *laissez-faire* empirically was made by advancing the so-called Environmental Kuznets Curve (EKC). Figure 3A depicts the inverted U-curve, suggesting that economic growth produces an automatic improvement in environmental quality.¹¹ Growth is measured as national income per capita, and environmental quality as emission of pollutants. The automaticity is explained by structural change (possibly towards a service-oriented and thus dematerialized economy) that comes with the transition from poverty to prosperity. The turning point varies between \$3,000 and \$35,428 of per-capita income in different studies and for different pollutants (Perrings 1998, p. 154). It is important to examine such automaticity since this idea seems to underly explicitly or implicitly many international proclamations on the necessity of economic growth for sustainable development, in particular in connection with the 1992 Earth Summit.¹²

The EKC hypothesis seems to hold for the emission of a few pollutants, notably NO_x, SO₂ and SPM (Perrings 1998). Wherever it applies it might be a good idea for developing countries to “tunnel through“ (Munasinghe 1999) the EKC hypothesis using the latest technologies and experiences with environmental management in rich nations (see Fig. 3A). Most recent assessments conclude, however, that the evidence for EKCs is far from conclusive.¹³ The reasons are, among others, uncertainty about what really causes the EKC effect, notably the role of growth-induced policy responses, the Figure 3

use of emission data to measure change in environmental quality, and difficult-to-know and -measure long-term irreversibilities from current pollution patterns.

My own assessment of material flow intensities for selected developing, newly industrialized (NIC's) and industrialized countries (Baretlmus 1997) is presented in stylized form in Figure 3B. At first sight the figure seems to confirm an EKC effect for NICs and industrialized countries, with less developed countries showing erratic movements. However, when taking absolute levels of TMR (per capita) into account, the EKC effect disappears as indicated by the dotted line in the figure. Considering further the politicized discussion of 'pollution of poverty' reflecting conditions of poor water, marginal housing, natural disasters, deforestation and desertification, on the one hand, and 'pollution of affluence' from overconsumption and waste/emission, on the other hand, one would have to reject the EKC hypothesis as illustrated in part C of Figure 3.

Relying on economic growth and/or price signals from markets does not seem to be a valid option: non-action looks indeed suspiciously like "passing the buck to future generations and other regions" (Rothman 1998, p. 191). The question is whether these generations and regions (whence to import sustainability) can or will accept the buck. If not, development could be replaced by 'developments' such as poverty-induced riots, war over access to natural resources, eco-terrorism, surge in ecological refugees and other social strife. Imports of economic and environmental sustainability would be offset in this case by social non-sustainabilities.

Not relying on market forces does not mean foregoing them. The application of market (dis)incentives and other policy instruments is the topic of the following section which takes a more (pro)active look at pushing and complying with environmental limits.

3.2 Tackling the limits: ecoefficiency, sufficiency and sustainable development

As tempting as it may seem to liberal economists – leaving the solution of environmental concerns to unfettered markets is probably a "foolhardy way" to learn about transgressions of environmental limits (Perrings 1995, p. 63). A first step toward tackling dematerialization and capital maintenance is to recast these notions in more strategic terms. Reducing the use of materials can be achieved by technologies which generate the same or even better 'services' from physical outputs with less resource inputs. As discussed above, such increase in *resource productivity* is the mirror image of a decrease in material intensity of production – the object of the Wuppertal Institute's MIPS approach to furthering ecoefficient production processes. A qualitative variant of this approach is the call for attaining "consistency" in the sense of developing materials and energy flows which can be seamless incorporated into and absorbed by nature's metabolism (Huber 1995).

For policy purposes the question is to what extent environmentally sound innovation can be steered into a desirable direction, for instance by market incentives or disincentives. The answer is as usual: it depends. "Exogenous innovation" (Atkinson 1999) which comes out of the blue, typically in a Schumpeterian process of creative destruction, is by definition hardly subject to policy inducement. "Endogenous innovation", on the other hand, can be triggered by governmental

incentives for R&D which should aim at enhancing not only produced but also human, social and institutional capital.¹⁴

Incentives or subsidies for particular economic sectors and activities are prone to social pressures, risking deviation from the original or proclaimed policy purpose. There seems to be an advantage in using *disincentives*, rather, in order to prod economic agents into internalizing their environmental costs into their budgets. Facing effluent charges or fees for excessive uses of environmental resources, producers and consumers are likely to search for techniques which replace harmful production and consumption processes by environmentally benign ones. The idea is to combine competitive and fiscal pressures to meet environmental goals in a more efficient manner than by command-and-control strategies of remote bureaucracies.

It is generally held, however, that technology alone cannot be the saviour: it needs to be reinforced by more or less voluntary restriction in consumption levels. ‘Ecoefficiency’ in production needs to be combined with ‘sufficiency’ in final consumption. Otherwise, efficiency gains could be offset by increased consumption, made possible by the very same efficiency gains. Sachs (1995) even pleads for a “sufficiency revolution“ since “nothing is as irrational as rushing with maximum efficiency in the wrong direction“.

So, how can we encourage or enforce ‘rational’ behaviour? Do we have to restrict consumer sovereignty to turn individuals into “model citizens“ (Hansen and Schrader 1997)? Is it enough to gain insight into true values by reflection and self-commitment (Scherhorn, in prep.)? The bottom line is how to influence individual behaviour without giving in to brainwashing through targeted education and moral suasion campaigns. Calls for ‘collective action’, ‘eco-detectives’ and ‘stick-and-carrot strategies’¹⁵ are dangerously close to eco-dictatorship. The good news is: liberal democracies and a vibrant civil society are well-equipped to watch out for overly zealous attempts at leading us into utopia.

4. Outlook: from social compacts to global governance

4.1 Reconciling the strategies: setting the normative framework

Note that, despite the above-described dichotomy in sustainability notions, both strategies of enhancing resource productivity and prompting cost internalization make use of market instruments for their implementation. This is however where agreement ends.

Dematerialization focuses on material inputs, e.g. by trading material certificates or charging user fees. Fiscal disincentives, on the other hand, deal with both resource depletion and environmental degradation, e.g. by means of targeted (costed) user fees, effluent charges or tradable pollution permits. More significantly, most environmental scientists believe that market instruments cannot do the job on their own. For instance, the Wuppertal Institute’s Factor 4 and 10 ‘guardrails’ are to change the course of production and consumption by calling for a drastic reduction

of material inputs. Curtailing consumer sovereignty through sufficiency criteria, guardrails or safeguards is of course anathema to environmental (neoclassical) economists. They favour market incentives and disincentives which focus on individual preferences and knowledge about environmental innovation and damage avoidance. Environmentalists, on the other hand, believe that individual, self-concerned preferences are bad judges of environmental impacts, especially of public health effects and the erosion of aesthetic, cultural, educational or ethical values; individual preferences need to be superseded by collective judgement and decision making.

How can we reconcile these apparently contradictory strategies? The answer is to combine them. An important first step toward reconciliation is to make vision visible by explicitly relating the set of social and environmental goals and norms to economic (market) activity. This could be done by specifying a normative framework within which economic activity could be played out.¹⁶ Such a framework turns the question of sustainability of economic growth into one of the “feasibility” of development. In this manner a direct link can be established between economic sustainability of production and consumption activities, performed within the framework, and ecological and social sustainability of development expressed in normative constraints.

Unfortunately, standards and regulations are typically scattered, with an emission or critical-load standard here, and an environmental rule or law there. Targets of social sustainability such as an equitable distribution of income and wealth or other political and cultural *sine qua nons* are rarely ever specified in quantifiable terms. In an open and democratic nation, civil society and government are called upon to negotiate openly and thus reveal minimum or desirable standards of living, and maximum environmental and social constraints, for meeting the standards and complying with the constraints.¹⁷

A *social compact* between ‘shareholders’, benefiting from economic activity, and ‘stakeholders’, suffering from its environmental effects, might do the job. Far from a Rousseauian *contrat social*, subsuming individual goals and aspirations to the ‘general will’, this could take the form of ‘alliances’ between state, commerce and civil society – possibly along the lines of the German *Bündnis für Arbeit* (Alliance for Work). Ideally, the result should be consensus and partnership in setting, implementing and monitoring sustainability targets and standards.

4.2 *Global change and sustainable development*

Much of the above focused on the internalization of social, especially environmental, values and costs into decision making of individuals and government at the national level. Some of the more generic thoughts, especially with regard to comparative international assessments of sustainability, should also be applicable at global levels. In particular, there has been an extensive discussion of sustainable development and globalization.¹⁸ It is however beyond this paper to review this topic in any detail.

Suffice it to point out that the above-described dichotomy between economists’ and environmentalists’ views of sustainability in growth and development re-emerges in the globalization context. On the one hand, ‘greens’ are asked ‘to love trade’¹⁹; on the other hand, globalization is considered to undermine

all categories of (economic, ecological and social) sustainability. The arguments run the gamut of praising the parsimonious use of scarce environmental resources, prompted by increased international competition, to warnings about a new commercial ‘imperialism’ of transnational corporations, at the expense of social, cultural and ecological concerns (Sachs, in prep.).

If indeed governments are downsizing or downsized (by powerful transnationals) – an issue that does require factual confirmation – we should certainly not leave global decision making to a particular interest group, e.g. of transnational corporations. Possibly, a “third force“ (Henderson 1997) of civil society is emerging from the grassroots as a countervailing power to monitor and counteract hegemonic contentions. However, democracy might fall through the cracks in such uncontrolled strivings, unless we succeed in creating an appropriate ‘global governance architecture’.²⁰

Notes

¹ *Der Spiegel* 8/1999. Never mind the ironic style in which this is presented, albeit not challenged.

² See for a review of the 'relative income hypothesis' (Duesenberry 1949) and its up-dated version of 'new consumerism', Schor (1998).

³ Happiness Web pages are sprouting in the USA according to Alexandra Marks of the Christian Science Monitor, referring to sites such as www.happyplace.net and www.sohp.com, where 'sohp' stands for the Secret Society of Happy People.

⁴ Point made by D. Pearce at the Second OECD Expert Workshop 'Frameworks to Measure Sustainable Development' (Paris, 2-3 September 1999), meaning that substitution of *total* stock is not necessary as sometimes assumed by critics of the weak sustainability criterion.

⁵ Environmental space is defined as "the quantity of energy, the non-renewable resources, the water, the wood and the farming lands that we can use in a sustainable fashion" (Buitenkamp, Venner and Wams 1993).

⁶ The assumption is that an equal environmental space should be reached by all countries in about 50 years while permitting a limited increase of material use in developing countries (Schmidt-Bleek 1993, p. 168).

⁷ The notion of human capital consumption is not an enticing concept. At any rate, whatever sustainability concept would be applied to human capital, it would not absolve from the need to invest or re-invest in human capital formation, i.e. education and training.

⁸ The SEEA (United Nations 1993) is designed as a satellite system of the world-wide adopted System of National Accounts (SNA) (United Nations *et al.* 1993). Compatibility with a standard accounting system has not yet been fully achieved in the MFA but material flows are more and more incorporated in environmental accounting and policy analysis (especially in Europe: see Spangenberg *et al.* 1999, p. 33). The following brief review of some results from material flow and environmental accounts is based on Bartelmus (1997).

⁹ Ecological rucksacks are defined as "the sum of all materials which are not physically included in the economic output under consideration, but which were necessary for production, use, recycling and disposal" (Spangenberg *et al.* 1999, p. 15).

¹⁰ See for a detailed discussion of valuation techniques and their rationale in environmental (national) accounts, Bartelmus (1998). A comprehensive critique of the MFA approach by Gawel (1998) is being met by a counter-critique (Hinterberger, Luks and Stewen, in prep.).

¹¹ Named after Kuznets's (1955) similar assessment of a correlation between the level and distribution of income.

¹² Cf. the preparatory publication of the Brundtland Commission (WCED 1987), Principle 12 of the Rio Declaration (United Nations 1994) and the outcomes of the follow-up conference 'Earth Summit +5' (United Nations 1997).

¹³ See notably a special edition of *Ecological Economics* 25 (2) (1998)

¹⁴ For example, such a policy has been considered as the "key to sustainable development" by the German parliamentary Enquete Commission on Human and Environmental Protection (Deutscher Bundestag 1998).

¹⁵ See for a concise review of these and other strategies of 'sustainable consumption', Scherhorn (in prep).

¹⁶ Similarly, Renner (1998) argues for overcoming the economic-ecological polarization by means of the "ordo-liberal" approach of the German Freiburg school of thought.

¹⁷ Focusing on key targets/constraints of this framework, sustainable development can be defined operationally as a "set of development programmes that meet targets of human needs satisfaction without violating long-term natural resource capacities and standards of environmental quality and social equity" (Bartelmus 1994, p. 73).

¹⁸ See e.g. Sandler (1997), Leisinger (1998), or the (German) Enquête Commission's (1998) Study Programme on 'Sustainability and Globalization'.

¹⁹ Cover page title of *The Economist* of 9-15 Oct. 1999.

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