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für Wirtschaftsforschung

# **Intergenerational Justice and Sustainability – Economic Theory and Measurement**

Expert workshop held

at the DIW Berlin

April 15-16, 2003

**Proceedings**



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# 1 Executive Summary

These proceedings document the results of the workshop on “Intergenerational Justice and Sustainability” which was held on May 15<sup>th</sup> & 16<sup>th</sup> 2003. It marked the beginning of a whole series of workshops that contribute to the research project on “Economics and Sustainable Development”. This research project aims at surveying economic approaches to sustainable development in a wide context of related scientific disciplines. It attempts to make out promising lines of economic research that can bridge the gap between mainstream neoclassical economics and ecological economics. The project is conducted by the German Institute for Economic Research (DIW) and funded by the German Federal Ministry of Education and Research (BMBF) which is considering to fund a major research programme on „Sustainability and Economics“.

This first workshop on intergenerational justice and sustainability consisted of several expert presentations as well as a concluding discussion to identify pressing research needs. The outcome of the latter is an agenda for economic research with regard to sustainable development. In particular, the workshop participants recommended:

- Performing cost-benefit-analyses with a special focus on strong sustainability policy options
- Widening the research horizon to global problems
- Examining implementation problems regarding policies for sustainability
- Analysing problems of resource depletion and environmental sustainability in the context of international security and stability
- Performing Generational Accounting assessment for policy reform proposals
- Developing criteria for measuring intragenerational justice
- Studying historical development paths and deadlocks regarding technology, the economy and the environment
- Assessing the role of financial markets regarding sustainable development
- Studying the formation of individual preferences
- Clarifying concepts of justice in general and of intergenerational justice in particular

The preceding discussions on intergenerational justice were divided in two distinct sessions with the first focussing on long-term environmental policies and the second on fiscal policy.

*Prof. Wolfgang Buchholz* opened the first session with reflections on the traditional welfarist approach regarding to intergenerational justice and sustainability. According to this approach, intergenerational allocation is a distribution problem with respect to utility. Aggregate welfare is measured by social welfare functions which encompass the utilities of current and future generations. Two important welfare functions are Maximin and Generalised Utilitarianism. Maximin is in conflict with ethical intuition whereas Utilitarianism might imply a too high burden for the present generation. Discounted Utilitarianism, however, is ethically questionable. Welfare functions can be used to describe the ethically relevant trade-off between the utility of present and future generations in a formal way. Related problems regarding utility include welfare measurement, the impossibility to predict future preferences or scarcities in a reliable way, (environmental) goods with non-existing market prices, and valuation in a world of uncertainty when subjective risk aversion matters. Therefore, resource based approaches may be more appropriate in the intergenerational case as practical guidelines for sustainability. These approaches include strong sustainability, weak sustainability and development aid.

*Prof. Malte Faber* described two specific out of many differences many between ecological economics and mainstream neoclassical economics. One difference arises from the picture of humankind. In this context, the concept of generational justice has to be rejected as too narrow if understood as distributional justice only. Instead, a more comprehensive notion of justice includes a just social order which is governed by the democratic rule of law and which preserves itself as well as its natural foundations. Such an order does not necessarily entail an equal distribution of goods between present and future generations. Moreover, the individual in such an order cannot be conceptualised as a mere homo oeconomicus. Here, further dimensions of human nature have to be taken into account. Another difference is the way in which nature is treated in ecological economics as opposed to mainstream economics. In the former, thermodynamic considerations are of central importance as an end to analyse nature-economy-interactions. Related issues here are joint production, irreversibility, uncertainty and responsibility. Finally, although the research on sustainability and economics generally has to be welcomed, a bridge between neoclassical economics and ecological economic does not exist.

*Prof. Ulrich Hampicke* argued that equity between generations cannot indicate economic sustainability, that the generation (and not the individual) is the appropriate subject of intergenerational justice, that welfare constitutes the object of intergenerational justice, that economists are in a bad position when debating strong and weak sustainability, that we are morally obliged to avoid serious evil for future generations, even those in the far distant future, that we need less theorizing and modelling on endogenous preferences and more practical steps towards more sustainability, that uncertainty regarding future values is unproblematic since primary values, i.e. physical needs which are the least variable do matter most, that uncertainty regarding future situations suggests to choose a maximin strategy as long as it is not too expensive and innovation-adverse, and finally, that intra- and intergenerational justice cannot be treated separately.

In the following discussion, the workshop participants encountered the problem of agreeing on a common definition of neoclassical economics and its perceived analytical limits. They also raised the issue of how difficult it can be to pursue new and interdisciplinary approaches within the economics community which, at least in decisive situations, mainly sticks to the neoclassical framework.

*Prof. John E. Roemer* gave a model-based presentation on intergenerational justice and sustainability. In his model, he studies an economy with a natural resource (a forest) that can either be harvested for timber to build houses or left in its pristine state to be enjoyed for recreation. The forest grows at a given natural rate, and individuals derive utility from hiking in the forest and from housing. There is an infinite sequence of generations, with a representative agent at each date, and there is technological progress over time, which reduces the amount of timber needed to construct a house. Roemer analyses the time path of timber harvesting which maximizes the welfare of the worst off generation under various specifications of the utility function. His main finding is that that an (egalitarian) optimal path could be consistent with a non-decreasing forest stock under rather moderate assumptions regarding the utility-function (CES preferences).

The following discussion covered issues related to Prof. Roemer's model such as uncertainty, substitutability of man-made and natural capital, future preferences, constraints on individuals, welfarism, and the rate of change that ecosystems can tolerate. In particular, the participants discussed the value of this kind of modelling from the perspective of ecological eco-

nomics. Also, some of them questioned the unbounded technological change as assumed in the model.

*Prof. Erling Steigum's* presentation dealt with the Norwegian economy, the government's petroleum wealth and the instrument of Generational Accounting (GA) as used in Norway. The main problem with the petroleum wealth is that it does not appear in national and public accounts. Therefore, these accounts overestimate income and saving when the petroleum wealth declines. In order to surmount this problem, the Norwegian government introduced GA in 1994 permitting to measure the departure from a sustainable fiscal policy. GA has been proved a useful tool in Norway for assessing fiscal policy and it is equally valuable for countries with large transfer programs. The precision of GA results, however, should not be overestimated, and the issue of risk adjustment is still unresolved. Finally, GA is not a substitute for, but a complement to building computable overlapping generation models and other growth models to analyse alternative fiscal policy strategies.

The following discussion concentrated on the changing attitude of Norwegian politicians toward long term policy consequences, the role of discounting in GA, the possibility of integrating intragenerational aspects into GA, other countries following Norway's example of weak sustainability, and the applicability of GA with respect to renewable resources.

Opening the second discussion session on fiscal sustainability, *Prof. Heinz Welsch* elaborated on the concept of sustainability, indicators of fiscal sustainability and related assessment tools. He described sustainability essentially as an inter-temporal concept that may require temporal constraints e.g. on inequality to be satisfied. Although environmental and fiscal sustainability are distinct issues, they can or must be studied jointly, for example, when natural resource rents accrue to the state or in the case of an ecological fiscal reform. The basis of fiscal sustainability indicators is the state's inter-temporal budget constraint. Generational Accounting is an assessment tool which can provide more detailed information than other indicators about the fiscal "sustainability gap". One crucial assumption of GA is the absence of general equilibrium effects. These can be dealt with by overlapping generation models which allow to study environmental and fiscal sustainability jointly within one unified framework.

*Dr. Stefan Bayer* presented a discounting technique called Generation Adjusted Discounting (GAD) for evaluating public projects with intergenerational effects that takes into account distributional aspects as well. GAD differentiates between intra- and intergenerational discount-

ing. Intragenerationally, each individual is allowed to discount effects within its own lifetime as it wants to discount them. Whenever the project-lifetime extends the individual's lifetimes, we have to discount intergenerationally. Therefore, the pure time preference rate cannot be used due to the contradiction of the utilitarian requirement for equal treatment of all affected individuals. For intergenerational, social discounting solely the growth time preference rate can be used. Employing GAD in intergenerational settings guarantees the fulfilment of intergenerational justice. All other discounting measures discriminate against future living individuals whenever equal income units are treated differently.

*Dipl.-Volksw. Christoph Borgmann* further elaborated on Generational Accounting. GA does not have a welfare economic foundation. It is solely a device of intertemporal budgeting in combination with the intertemporal budget constraint of the government. The intertemporal budget constraint says that the sum of all discounted future primary deficits has to equal today's government wealth. Besides GA, econometric approaches and the OECD method are common in the literature on fiscal sustainability. GA and the OECD approach are familiar in that they take future demographic developments into consideration. They differ, however, with respect to the assumptions about age-specific incidence of taxes and transfers and with respect to the terminal condition. As to the relation between GA and OLG models, there is a lot of research to be done which, unfortunately, is not highly rewarded in the scientific community.

The following discussion was about the possible adaptation of GA to environmental sustainability, the strengths and weaknesses of overlapping generation modelling and optimal control approaches as possible alternatives to GA, and on the pros and cons of keeping the pillars of sustainability apart instead of moving toward more integrated analysis.

## 2 Introduction

The workshop “Intergenerational Justice and Sustainability” is part of a DIW research project on “Sustainability and Economics“, which is funded by the German Federal Ministry of Education and Research (BMBF). This survey project consists of several workshops on economic and related sciences approaches to sustainable development and a questionnaire on “Economics and Sustainable Development”. The first three workshops in 2003 are “Intergenerational Justice and Sustainability” (15<sup>th</sup> & 16<sup>th</sup> May), “International Institutions for Sustainability” (12<sup>th</sup> & 13<sup>th</sup> June), and “Measuring Sustainability” (3<sup>rd</sup> & 4<sup>th</sup> July).

The project is motivated by the observation of a scientific divide in economics. One indicator of this divide is the fact that the concept of sustainable development is still being ignored by many mainstream neoclassical economists. As an alternative line of research the merger-movement of “Ecological Economics” has formed. It investigates various aspects of sustainability and consists of many different scientific approaches, joined by their frontiers with mainstream neoclassical economics. Also, in general, the theoretical and methodological contribution of economics to sustainable development (SD) seems to need further elaboration. The survey project thus aims to identify both, pressing research needs and promising lines of economic research. It also aims to identify concepts that may bridge the gap between economic approaches (e.g. neoclassical economics, ecological economics, evolutionary economics) and provide a multi-dimensional mindset to overcome the current constellation of “schools of thought”. The project is based on an integrative concept, which we have labelled “Sustainability Economics” (SE). The key features of the Sustainability Economics concept are:

- a) A comprehensive approach encompassing the ecological, economic and social dimensions of sustainability,
- b) the development of economic methods and concepts that deal with problems of sustainability,
- c) a strengthening of policy-orientated economic approaches for sustainability,
- d) an integration of sustainability concepts of general economics (such as sustainable finance) into the environmental economics SD debate,
- e) and an identification of “bridges” between different economic “schools of thoughts” by means of studying integration and disintegration processes in general science and exploring venues of interdisciplinary approaches.

The survey is carried out through a series of workshops and a questionnaire on “Economics and Sustainable Development”.

These proceedings document the results of the first workshop on “Intergenerational Justice and Sustainability – Economic Theory and Measurement” which took place on May, 15-16, 2003.

The workshop departed from the finding that underlying many disputes on the concept of sustainability are some philosophical and ethical differences on the problem of intra- and inter-generational equity. These differences had been laid out in a background paper which had been provided in preparation of the workshop (Schwarze et al. 2003).

The background paper surveys theories of distributive justice as they are discussed in philosophy and political science, and relates these theories to economic definitions of sustainability. It also works out the underlying assumptions of these theories and how they tackle the key problems faced by a definition of sustainability, i.e., who is the subject of intergenerational justice (the individual or the generation), what is the object of intergenerational justice (welfare or resources), which obligations exist to future generations and how should we deal with uncertain future preferences and situations.

The second part of the background paper concerns the economic measurement of intergenerational justice. It explores the methods of generational accounting and overlapping generation (OLG) models in a context of fiscal policy. Both methods aim to determine the effects of fiscal policy by age groups (and potentially other attributes such as gender) for present and future generations. In the paper, the basic methodology and limitations and criticisms of these tools are discussed.

The proceedings from all workshop of this research project including the questionnaire results will be published and made available at our website [www.sustainableeconomics.de](http://www.sustainableeconomics.de) in 2003 and 2004.

### 3 Workshop Participants

Dr. Stefan Bayer  
Eberhard-Karls-Universität Tübingen  
Institut für Volkswirtschaftslehre,  
insbesondere Öffentliche Finanzen und  
Umweltökonomie

Christoph Borgmann  
Universität Freiburg  
Institut für Finanzwissenschaft

Prof. Dr. Wolfgang Buchholz  
Universität Regensburg  
Institut für Volkswirtschaftslehre

Prof. Dr. Malte Faber  
Ruprecht-Karls-Universität Heidelberg  
Interdisziplinäres Institut für  
Umweltökonomie

Karen Feist  
GSF - Projektträger des BMBF für Um-  
welt- und Klimaforschung  
München

Bernd Fischer  
Bundesministerium für Bildung  
und Forschung  
Ref. 624 Wissenschaft und Gesellschaft  
Bonn

Prof. Dr. Ulrich Hampicke  
Ernst-Moritz-Arndt-Universität Greifswald  
Lehrstuhl für Landschaftsökonomie

Dr. Daniela Krysiak  
Technische Universität Berlin  
Fakultät VIII: Wirtschaft und Management

Prof. John E. Roemer  
Yale University  
Elizabeth S. and A. Varick Stout Professor  
of Political Science and Economics  
Department of Political Science

Thomas Schulz  
GSF - Projektträger des BMBF für  
Umwelt- und Klimaforschung  
München

Prof. Erling Steigum  
Norwegian School of Management (BI)  
Department of Economics  
Sandvika, Norway

Jörg Tremmel  
Vorstandssprecher der Stiftung  
für die Rechte zukünftiger Generationen  
Oberursel

Prof. Dr. Heinz Welsch  
Universität Oldenburg  
Institut für Volkswirtschaftslehre I

#### **Participants from the DIW Berlin:**

Matthias Deutsch  
Susanne Dröge  
Dr. Dietmar Edler  
Michael Kohlhaas  
Prof. Dr. Georg Meran  
Dr. Reimund Schwarze  
Dr. Louise Stewart-Ladewig

## 4 Session I :”Intergenerational Justice and Long-term Environmental Policies”

### 4.1 Statement by Prof. Wolfgang Buchholz

#### 4.1.1 The Traditional Welfarist Approach

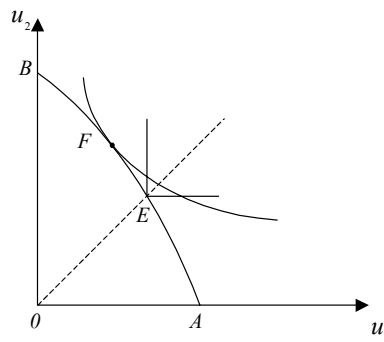
##### 4.1.1.1 Description

Intergenerational allocation is a *distribution problem* w.r.t. utility.

Utility (well-being) of a generation reflects everything that is relevant from the perspective of distributional ethics.

The main arguments can be described in a two generation setting:  $t = 1, 2$

Utility of generation  $t = 1, 2$  is given by  $u_t$



$AB$ : Transformation curve

Specific assumption in the intergenerational context:  $|\text{Slope of } AB| \geq 1$

The economy is *productive*:

Utility can be postponed & there is a compensation for waiting.

Aggregate welfare  $W(u_1, u_2)$  is measured by *Social Welfare Functions* (SWFs).

Two important types of SWFs:

a)  $W_m(u_1, u_2) = \min\{u_1, u_2\}$  (*Maximin*)

b)  $W_h(u_1, u_2) = h(u_1) + h(u_2)$ , where  $h(u)$  is non-decreasing

(*Generalised Utilitarianism or Prioritarianism (Roemer (2003))*).

The concavity of  $h(u)$  indicates the degree of *inequality aversion* in social evaluation (e.g. *Atkinson (1970)*).

If  $h(u) = u$  *Pure Utilitarianism* is obtained as a special case.

If inequality aversion goes to infinity maximin is (approximately) obtained.

#### 4.1.1.2 Evaluation within the Welfarist Framework

1. The welfare functions a) and b) fulfil *Weak Pareto* and *Anonymity* which are sensible ethical axioms in the intergenerational context.
2. In the intergenerational context maximin is in conflict with ethical intuition (e.g. *Solow* (1974)): Making use of productivity is excluded. At point *E* generations may be forced to stay in poverty. Therefore, even *Rawls* (1971) himself did not propose maximin in the inter-generational case.
3. All SWFs a) and b) will choose sustainable paths (with  $u_2 > u_1$  on the segment *EB*) as maximal elements (*Asheim/Buchholz/Tungodden* (2001)).
4. The problem with SWF's b) rather is that (in point *F*) they might imply a too high burden for the present generation  $t = 1$  - when investment is highly productive and  $h(u)$  is not very concave (e. g. *Arrow* (1999)). This is the classical criticism against pure utilitarianism in the intergenerational context. This motivates introduction of a discount factor  $\delta < 1$  .  
*Discounted utilitarianism* (DU) as asymmetric SWF:  $W^\delta(u_1, u_2) = u_1 + \delta u_2$
5. Discounting is ethically questionable as it means *unequal treatment* of generations (e. g. *Ramsey* (1928)).
6. DU will imply non-sustainability (i. e. decreasing utility) when productivity is low and decreasing and the discount factor  $\delta$  is small. In a multiple period framework this problem might be mitigated by allowing for time-varying discount rates (e. g. *hyperbolic or gamma discounting* in *Weitzman* (2001)).
7. Protection of the present is equally possible by adjusting (the curvature of)  $h(u)$ . Undiscounted utilitarianism is sufficiently malleable (*Asheim/Buchholz* (2003)).

This is a purely formal (but important) discussion in the framework of Ethical Social Choice Theory. An important practical consequence of this discussion could be that criteria for choosing long-term discount rates have to be reconsidered.

## 4.1.2 More Fundamental Problems with the Welfarist Approach

### 4.1.2.1 The Status of SWFs

A *modest* (uncontroversial) *interpretation*:

SWFs are expression of subjective ethical preferences: intergenerational altruism on a personal level perhaps combined with some *warm glow of giving*.

But why should these altruistic preferences satisfy Anonymity?

A more *ambitious* interpretation:

SWFs express absolute ethical values chosen behind a veil of ignorance.

This view seems to be at odds with the individualistic approach in economics.

In the intergenerational context, however, dismissing the ethical content of SWFs is not that easy:

- Future generations cannot defend themselves against greed of the present. As they cannot have *property rights* in a legal sense they should at least have more rights.
- If there are no moral limits to the actions of the present generation *economic progress* as a central objective of economic activity is in danger. This in particular holds true when the regenerative capacity of natural assets is low or negative.
- Fairness in the sense of (virtual) *reciprocity* may require that we do something for the future generations as the past generations have done something for us. There is something like a chain of obligation.
- Even in the Lockean-Nozickian tradition there is the proviso that appropriation should be restricted: People should leave "enough and as good in common for others". This moral guideline specifically applies to the use of natural resources (Roemer (1996, p. 206)), and it should be applied to the treatment of future generations.

*Implications*:

The trade-off between utility of the present and the future generation is ethically relevant.

SWFs can be used to describe this conflict in a formal way. The use of SWFs in the intergenerational context seems to be more appropriate than in the intragenerational case.

### 4.1.3 The Status of Utility

There are the *traditional* problems w.r.t. welfare measurement:

- monetary valuation of interpersonal comparability
- aggregation

No objective results of valuation seem to be possible.

These problems are exacerbated in the intergenerational context:

- It is impossible to predict future preferences and scarcities in a reliable way.
- More (environmental) goods for which no market prices exist are involved.
- There is more arbitrariness in valuation as subjective risk aversion matters much in a world of uncertainty.

Therefore *resource based approaches* (as suggested by *Dworkin* (1981)) may be more appropriate in the intergenerational case.

This could make it easier to get practical guidelines for sustainability:

- Save stocks of natural resources that are important, non-sustainable and non-renewable (e.g. conservation of biodiversity and natural sites). This might be seen as a moral imperative in its own right (*Barry* (1999))("Intrinsic Value of Nature"):  
*advocates of strong sustainability*
- Provide (by F&E policy) substitution technologies that enable mankind to do without exhaustible natural resources (oil, coal, ...):  
*advocates of weak sustainability*
- Provide the means that basic functionings (*Sen* (1993)) and goods (nutrition, health, ...) are permanently available to all people.  
*advocates of development aid*

Fulfilment of these tasks will not imply intergenerational equity in a strict sense (if this were possible at all). But uncertainly precludes more ambitions objectives - even from a moral perspective!

Note

- that there are potential conflicts between these objectives.
- that a high speed of population growth will impede the realisation of these objectives.

#### **4.1.4 Implementation of Sustainable Allocations**

*Pessimism:*

A successful policy might require more

- redistribution
- cooperation among states

then realistically can be expected.

*Optimism:*

People might voluntarily do a lot for their own future which (as creation of knowledge) automatically benefits future generations.

But there are market imperfections by which provision for the future is reduced below its optimal level, and environmental values are not taken sufficiently into account.

#### **4.2 Statement by Prof. Malte Faber<sup>1</sup>**

I would like to deal with the relevant questions of this session by making some general remarks to the differences between mainstream neoclassical economics and ecological economics. The frontier between these two approaches has many dimensions. Here I will limit myself to two dimensions which I consider essential for the research programme on sustainability and economics: I) The *picture of humankind*. Within this context I shall examine the behavioural models and the concept of generational justice as the appropriate subject of generational justice. II) Thereafter I will be turning secondly to *the way in which nature is treated in*

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<sup>1</sup> I am grateful to Thomas Petersen, Reiner Manstetten, Christian Becker and Stefan Baumgärtner for discussion and constructive comments and Dale Adams for translational aid.

*economics and ecological economics*. Here I shall deal with production, irreversibility, uncertainty, and responsibility.

#### **4.2.1 The picture of humankind**

One of the most prominent concepts in economics is the concept of the homo oeconomicus. In attempting to establish conditions for sustainable development it is becoming more and more evident, however, that this concept is an unsuitable element of analysis. Conceived as an universal and unique conception of human behaviour, the concept of homo oeconomicus even appears to be an obstacle. For this reason, additional alternative concepts of human behaviour have been developed: e. g. homo politicus and homo sustinens. In these concepts the notion of justice is of crucial importance. What relationships exist between these concepts and generational justice? To this I have two points to make:

- The expression 'generational justice' is founded on a limited concept of justice. It deals solely with justice in regard to distribution. Distributional justice deals with the distribution of goods such as food, clothing, health care, human rights etc.. Such goods can be given and taken away. As a rule they only represent a good to whoever possesses them. Philosophical theories of distributional justice deal with the question of the correct way in which to distribute. Mainstream economic theory in form of paretian welfare economics and in particular the new political economics also deals with the question of the distribution of goods. Therefore, a close relationship exists between philosophy and economics in respect to distribution. However, distributional justice is a very limited form of justice. The meaning of justice in political philosophy extends far beyond the simple distribution of goods. We can, for example, also call an entire political or social order 'just'. In this manner we can say that a just social order for humankind is the democratic rule of law. And a just human social order includes the stipulation that it preserve (i) itself and (ii) its natural foundation of existence. We furthermore ascribe justice as a characteristic to human beings. My hypothesis is as following: We require a comprehensive concept of justice in order to deal properly with questions of sustainability. In order to found this hypothesis I now turn to my second point.
- The term distributional justice does not suffice to define the term sustainability. This has two reasons.

- The question of sustainability is not first and foremost a question of the distribution of resources and so forth between different generations. It is much rather the aforementioned question of the preservation of a comprehensive order of human life. Since we do not wish to preserve simply any old order, the next question arises: exactly which order do we wish to preserve? A necessary precondition for such an order is that it be just in the comprehensive sense. This does not, however, necessarily entail an equal distribution of goods between present and future generations. Would it for example, be necessarily unjust if future generations were no longer able to operate automobiles? Such a point is certainly arguable, but in my opinion this is definitely not the case.
  
- The tenets of justice lay the foundation for a demand for sustainability. Demands for justice, however, are up in the air as long as one does not refer to people in whose interest these demands are to be. In order to do this meaningfully, one requires a concept or picture of humankind. Let me clarify this with an example. An adequate concept of humankind with regard to justice is found in Immanuel Kant. Kant regards general moral obligations as the consequences of practical reason. Practical reason obligates justice in an absolute sense. That means: There does not exist a trade-off between justice and anything else. For example, there does not exist a price for the dignity of humankind. But it is not self-evident that this obligation to justice has significance for humans. This is only the case if people *want* to be reasonable beings and are prepared to listen to their practical reason. In short: Moral philosophy stands or falls on a specific picture of humankind and this specific picture is the following: humans are *reasonable beings* and regard themselves as such. As a consequence, in regard to reflections on justice one must always take the individual as one's starting point. But the question is: according to which picture of humankind one is to conceptualise the individual? If it were the last word that humans be merely *homines oeconomici*, that is to say, merely rational utility maximisers, then it would not be necessary to speak of justice beyond the fulfilment of contracts – let alone of absolute demands one could make toward them. The stipulation of sustainability only makes sense if one can take further dimensions of human nature other than that of the *homo oeconomicus* into account.

I shall now proceed to my second point on the differences between mainstream economics and ecological economics:

#### **4.2.2 The conditions of production which concern the way in which nature is treated in economics and ecological economics**

In mainstream economics, nature in the form of land, resources or waste-assimilation capabilities is regarded solely as a production factor. The lack of conceptual underpinning of nature in economic theory becomes particularly evident when one regards how mainstream neoclassical economics deals with production. Although the transformation of inputs into outputs is a natural scientific phenomenon, the production function was not originally developed to explain how factors of production are transformed into products, but only to explain the distribution of income to the production factors.

Another deficiency of the neoclassical concept of production is that irreversibility is not defined in accordance to the laws of thermodynamics<sup>2</sup>. In contrast to neoclassical economics, nature has a central role in ecological economics in the analysis of nature-economy-interactions. To this end thermodynamic considerations are of central importance. The entropy principle is one of the foundational notions of ecological economics (Nicholas Georgescu-Roegen 1971). Using the entropy principle it becomes obvious that production processes are irreversible in closed (speaking precisely in terms of physics: isolated) systems. During the last decade, a link was developed by ecological economists between thermodynamics and the theory of joint production. From the laws of thermodynamics it follows that; speaking generally, all production is joint production. That means it is not possible to produce a good without producing at least one, in most cases however many, joint products. Some of these joint products are necessarily waste products.<sup>3</sup> The generation of joint products creates a severe problem for our responsibility. To analyse this problem, it is important to note that two kinds of ignorance arise because of joint production. First, we do not know all the characteristics and effects of a joint product in nature, e.g. think of the CFCs which caused the ozone hole. Second we do not know all the joint products of a production process (e.g. think of Seveso dioxin).

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<sup>2</sup> Temporal and thermodynamic irreversibility: Irreversibility has been conceptualized in production theory in different ways. Not all of these concepts are in full accordance with the laws of nature. It has been shown that Koopmans' (1951) notion of irreversibility captures both temporal and thermodynamic irreversibility, and that the weaker notion of Arrow-Debreu (1954, 1959), while establishing temporal irreversibility, does not encompass thermodynamic irreversibility (Baumgärtner 2000, Chap. 11; Baumgärtner, submitted 1)

<sup>3</sup> For an encompassing economic and thermodynamic discussion see Baumgärtner and de Swaan Arons (2003).

One can only be responsible for those consequences of an action, which one is aware of or which one could at least foresee. The increasing complexity of the interactions of joint production in one period of time and especially over the course of time significantly reduces the possibility of assuming responsibility for the consequences of one's actions. Thus, joint production raises the question of responsibility in a new way.

To summarize, I welcome the project of intensive research on sustainability and economics funded by the BMBF. Quick and handy results are not to be expected. Why is this so? The background paper to this workshop aims to bridge the gap between mainstream neoclassical economics and ecological economics. But in my view such a bridge does not exist. To illustrate my point: the different natural sciences and social sciences are like floors in a skyscraper. There is a basement containing philosophy in general and the foundations of science. On each of the following floors the different natural sciences are situated, followed by the different fields of social sciences and the humanities. Thus, mainstream neoclassical economics is situated somewhere around the 11th floor. On this floor excellent instruments, methods, approaches, data, and policy recommendations are available. Good work is done on this floor. Ecological economics, however, is located primarily in the basement and on the lower floors. In this part of the building a tremendous part of the work still has to be done. The status of the discipline of ecological economics is by no means as sophisticated and elaborated as in mainstream economics. And as of yet there is no simple elevator, not even a ladder which leads from the floors of ecological economics to the region of mainstream neoclassical economics. It is not possible to take parts of the basement and to implant them into the perfect machine of mainstream economics. Concerning sustainability, mainstream economics is up in the air without ecological economics. But it will take a lot of time and effort until ecological economics offers a conceptual framework in which neoclassical economics can be integrated. I am afraid, if we are really interested in sustainability we have to be prepared to go a long way until we are able to provide such a conceptual framework.

#### **4.3 Statement by Prof. Ulrich Hampicke**

In order to save as much time as possible for the discussion; I strictly confine myself to answering the questions which have been posed to me.

### **4.3.1 Can equity between generations be used to indicate economic sustainability?**

My answer to this simple question is no. A situation is imaginable where a chain of, say, 10 generations live in perfect intergenerational equity – no generation can claim to be disadvantaged by its predecessor – and yet the whole economy is unsustainable. After 10 generations resources have been used up. Theoretically, the question can be answered in the affirmative only in the case that any arbitrary number of generations belongs to the equity club. In practice, this can of course never be known so that the construction is rather artificial. It appears to me that it is more sensible to state the other way round: Whenever we attempt at providing for sustainable resource use we foster equity between ourselves and future generations. Whether equity equals justice is another and very deep problem.

### **4.3.2 What is the appropriate subject of intergenerational justice? the individual, or generations, or ...?**

Microeconomic textbooks say that economic theory adheres to both methodological and normative individualism. Every feature of the macro world should be traced back to the micro dynamics in order to be understood and the individual should be the final addressee of all economic inquiry.

For decades, growth theory and resources economics have wronged these principles in that they maximised sums of individual welfare, added up both intra- and intergenerationally, without caring for the distribution of such maximised mountains of utility among the individuals affected, as criticized by Rawls, for instance. The neoclassical mainstream is in this respect a distinctly collectivist school of thought. How should we think?

In principle, the individual is the appropriate subject of intergenerational justice and nothing else. It is our duty to foster the well-being of future individuals. The question is: can we directly delight or harm future individuals? As stated in the background paper, philosophers have identified some points where we directly impinge at least on individuals of the next generation. In fact, we are producing them and deciding about their very number. In the future, medical progress may seduce parents to decide the gender of their offspring, not to mention the application of breeding schemes we deliberately apply to our domestic animals. Also, education, formation, pedagogic and our practical conduct can and do influence the preferences of the next generation.

All these problems have profound moral aspects, I shall return to some later. Here I only remind that we have no direct contact to future generations beyond our children and grandchildren. For an individual, it is impossible to be just or unjust to another individual in the remote future just as it is impossible to be to a contemporary stranger. If I never meet an inhabitant of Papua-New Guinea I cannot behave morally or immorally towards him. This is one of the few important differences between inter- and intragenerational justice. The former is much more of a political phenomenon: We are obliged to ask ourselves whether our collective, not our individual decisions are morally justified with regard to futurity, for instance, our decisions on energy systems.

Even collectively, our impact on the individual is limited. For instance, we cannot prevent future generations from realizing a very unjust intragenerational distribution at their time such that many individuals will become deprived of benefits we intend for them in choosing a sustainable path. We might take comfort from the fact that we would not be responsible if such unwelcome future came true. On the other hand, we must admit that we ourselves, the present humanity on Earth, is maintaining a very unjust worldwide distribution. Our ancestors, though not deliberately engaged in sustainability, saved a lot of man-made capital we are now profiting from. As a German saying goes, they might turn in their grave could they witness the present distribution of their savings.

What we can do in practice is to save resources and to accumulate capital such that future generations will have the opportunity for a decent existence. My answer to the question is that we can do very little for individuals in the more remote future. It is an interesting philosophical question whether this is good or bad.

#### **4.3.3 What is the appropriate object of intergenerational justice; welfare or resources and which resources?**

Of course, welfare is the end of any economic activity, resources are mere means. This is true in both intra- and intergenerational contexts. Again, we must do what can be demanded from us in order to enhance future human life, or, more practically, we must, if we can, avoid everything which is likely to cause serious evil in the future.

Every person's happiness, in present and future, is determined by both his preferences and his resources. The one who owns much but does not like it may be as unhappy as someone owning too little. In the context of a family and comprising only 2 or 3 generations, both aspects

are relevant. The grandmother, knowing that her poor son can bequeath only very little may teach her grandchild, perhaps successfully, that it is a virtue to live unpretentiously, that being too rich is wrong. In economic parlance, she is generating cheap tastes.

It goes without saying that the formation of preferences in a society is an extremely important thing. Personally, I am dissatisfied both with the way economic science is handling this problem, and, much more so, with the real preference-generating process in our society where, apparently, the word more and more and more is the only word known.

On the other hand, the impact on other peoples' preferences is limited, and rightly so. I am sure that cases can be found where children resist their parents' desire to implant into them wrong preferences, for instance that one should profit from other peoples' work rather than to work oneself or that it is apposite to reach one's ends by means of violence.

I welcome that it is practically impossible for us to influence the preferences of future generations. At large, our generation is setting few good examples such that it could be recommended as a teacher. Worse: we might be tempted to act collectively like the grandmother in my example. While the grandmother is absolutely innocent as to her grandchild's poor resource endowment, as society we may preach water to futurity after having drunk the wine. In an intragenerational setting nobody would accept if Germans tried to persuade Bangladeshis to dislike cars.

Preferences being practically unaffected by us, the only way to act is to confer resources, to confer capital. This is very simple. Which resources should we bequeath? The answer is: everything – natural capital, human capital, skill, humanity, technical capital. Some skills deserved to become lost – the skill to produce deadly weapons, for instance – but this is, sadly, very unlikely. How much capital should be conferred? Although the question is very difficult to answer in detail, it is simple in principle: Intergenerational justice is symmetrical. Future generations can demand from us to respect their well-being but cannot demand every imaginable sacrifice. It would be unjust if present people had to bear immense costs for the sake of trivial future benefits. Therefore, the decisive figure are the preservation costs. What is cheap to preserve must be preserved without discussion, future people may or may not use it. Regarding very expensive assets of, for instance, natural capital, we must ask futurity to do without them, and in between – neither very cheap nor very expensive – a high-quality debate has to be held permanently where economics plays a central part. It is remarkable that econo-

mists are discussing everything regarding sustainability but little empirical work is carried out as to the sustenance costs.

#### **4.3.4 What are the underlying assumptions about substitution processes, production possibilities, and ecological processes?**

The question addresses the schism between strong and weak sustainability which I think everybody here is familiar with. Adherents of the weak principle are optimistic regarding substitution possibilities between natural and man-made capital so that they admit reductions of the former provided the latter increases adequately. Adherents of strong sustainability claim that technical capital can be added to natural capital but cannot replace it so that natural capital must be preserved in any case.

Whenever two economists debate over this problem they are in the same position as two physicians debating about music. The latter debate may be of high quality provided the physicians are musical and well educated but it is safe to say that they do not exchange arguments of medical science. They are discussing matters beyond their profession. So are economists when debating strong and weak sustainability. If the question is posed in technical terms we are contemplating the shape of isoquants. Are sewage treatment plants perfect substitutes for the self-purifying capacity of natural ecosystems? Is anybody in this room who knows about sewage treatment plants? I know a little bit just as the physician playing piano in his leisure time but if I had to take an important decision I would consult an engineer. It is the engineer's task to draw the isoquant, the professional economist joins the discussion when attention turns to costs.

If the question is posed in psychological terms we are contemplating the shape of indifference curves. As early as in the 1960s an important article asked whether humans might happily put up with plastic trees after a hypothetical eradication of living trees. For sure, I would not trust any answer given by an economist. Rather, I would consult a psychologist or anthropologist. Whether man-made capital can or cannot, in specified situations or altogether, replace natural capital is an empirical question completely outside the realm of economics.

Unfortunately, I know from experience that in both cases, engineers and psychologists will give ambiguous answers. The truth is that nobody knows. Of course, if nobody knows the best prima facie strategy is to preserve everything including natural capital. This is the objective of strong sustainability. This strategy is wrong if it is too expensive, if preserving everything will

distract resources from more urgent tasks, both in the present and future. Unfortunately, it is almost universally taken for granted in the professional debate that this is the case. For many scientists it goes without saying that strong sustainability is unaffordable, and this is the very reason they are opposed to it. Now this is again a purely empirical question, but this time the economist is the professional expert. We have to calculate. I regret that so few economists are engaged in finding out the opportunity costs of different strategies, especially of strong sustainability. We assume them to be too high, but do we know? If we formulate the sustainability problem in our habitual way, that is, maximise present welfare under the condition that a potential for the future is preserved, the values of the Lagrange multipliers represent the opportunity costs. I did some empirical work in a narrow but important field of strong sustainability, in nature conservation and can state that in rich countries the opportunity costs of avoiding extinction are in many cases trivial and that even in poor countries they are far from unaffordable, for instance in the case of rainforest preservation.

#### **4.3.5 Which obligations to future persons exist, and how far do they reach?**

Let me begin with the second question. It is often argued that our obligations cannot reach very far because the distant future is too dim to be influenced by our actions. I think that we have a categorical error here. To be or not to be morally obliged is independent from the likelihood with which our decisions practically affect others. As stated earlier, it is unlikely, according to my prevailing experience, that my decisions affect the well-being of an individual from Papua-New Guinea. It does not follow that I have no moral obligations to the inhabitants of this country. Should I happen to meet one of them this afternoon, perhaps in this room, my obligations towards him or her are exactly the same as to Prussians and Bavarians I use to come across more frequently. In principle, our obligations extend to all future people. We may even find empirical cases where our neglect might cause greater evil to the distant than to the near future, for instance when producing plutonium. While the danger associated with this radioactive product will hardly decrease during the next one thousand years, the information where it is buried may get lost more quickly so that the remote future will face a greater hazard than the near future.

Which obligations exist? Not too many I think. As we parents know, concern for our children often proves futile and psychologists know that too much concern may even be wrong. Future people will make their mistakes just as we did. Also, we cannot ask them about every detail of our present actions which will influence their well-being. If we plant trees now or construct

long-lasting buildings, these may or may not satisfy future people's tastes. They might prefer oak trees while inheriting beeches from us. All this is not very important.

I think there is one fundamental duty, that is we have to do everything we can do and can be justly demanded from us to avoid serious evil for future generations. It is not difficult to imagine what serious evil is because we permanently witness such things in our own generation. We have to work against everything which can deprive future people of means to meet their basic needs, jeopardises their health, self-esteem or even their lives. With Rawls, we might say simply that we are responsible for preserving the opportunity for a plentiful supply of primary goods. This is not to say that we should deliberately plan the future such that only primary goods are supplied and nothing beyond. This debate between egalitarians and non-egalitarians is much richer. But it is difficult for me to accept a moral obligation to supply non-primary goods to someone else today or in the future as I do not expect any other person or the community to feel morally obliged to supply me with, say, a private boat.

Of course, empirical and practical problems abound. The question posed does not ask me to go into details. I mention just one case in point: every ton of topsoil which is eroded and wasted on some continent today is a step towards jeopardising decent lives in the future so that we should make great efforts to stop soil destruction now.

#### **4.3.6 For which preferences and which aspects of their situation should people be held responsible?**

There is wide agreement today that responsibility is something we owe to others although philosophers have also suggested responsibility to oneself. According to the agreement I am responsible for my preferences if they affect others. It is clear that one must not develop preferences one would not accept if expressed by others, for instance the preference to hurt others. But the old liberal question emerges: Is there anything which does not affect others? On the face of it I should be absolutely autonomous in choosing whether to drink coffee or tea. I know, however, that in choosing I either benefit coffee farmers or tea farmers. Am I obliged to take these consequences into account? I must admit that I cannot answer this question, especially within the context of intergenerational justice. We have to discuss.

#### **4.3.7 Do we need economic models of endogenous preferences to tackle the problem of intergenerational equity?**

According to my statement that we are in the first place responsible for the future adequacy of primary goods the answer is clearly "no" because primary goods are not a matter of preferences but of needs. Of course, they are not only defined in physical terms – every man receives 10 megajoule of food energy per day – but are culturally determined. For instance, access to education is an important primary good. But in my view the prevailing theorizing on endogenous preferences (including imitation effects, snob effects and so on) is inadequate and unnecessary here. By the way, we should take practical steps towards more sustainability rather than build more models.

#### **4.3.8 How to deal with the uncertainty of future values and preferences?**

My answer is analogous to that on the last question: Primary values, although they are culturally determined, are the least variable of all values. Definitely, this is true for physical needs. As Brian Barry put it 20 years ago: future people are very unlikely to develop a preference for skin cancer so that we have not the slightest problem in defining our present duties regarding the Earth's stratosphere. Of course, not all problems are as clear cut as this. Again, I recommend to take action where things are clear and simple rather than to indulge in the most complex intricacies. For instance, to invest in clean water supply systems in at least one hundred countries in the world will save innumerable lives and reduce terrible illnesses, is not expensive by western standards, is technically uncontroversial and is least likely to prove as a misinvestment future people will be uninterested in. Why don't we start right now?

#### **4.3.9 How to deal with the uncertainty of the future situation?**

I think there is no short answer because the term "situation" is ambiguous. We know for sure that the laws of physics will also apply in the future, a stone will fall from the roof and will never climb upwards. So far, the "situation" will not change. The natural environment may change for non-anthropogenic reasons, imagine a new glaciation. Far more likely and important are changes of the natural environment caused by man. We don't know whether in 2060 the average temperature of the globe is raised by 1.5 or by 4.5 degrees, according to estimates given by climatologists. The term "situation" also encompasses the development of human technology. If we succeed in breeding salt-tolerant crop plants, the world food situation will

greatly improve. Finally, human behaviour, morals, peace or war, will be parts of the future data setting.

We cannot say more than what we learned from established decision theory. We might try to arm ourselves for the worst possible outcome in choosing a maximin strategy. This might be recommendable in some selected cases where very serious damage can occur. The strategy is probably too expensive, conservative and innovation-adverse to be applied everywhere. An important aspect is enhancing the adaptability of future people to climatic change, for instance. Relatively wealthy people will much better adapt themselves than people on the brink of starvation even without climate change. All this is well-known so that I need not go on.

#### **4.3.10 Can intra- and intergenerational justice be treated separately?**

It cannot, for all humans deserve the same dutiful behaviour on the part of their fellow-humans no matter when they live. In practice, someone caring for great-grand children who will be possibly less well-off but ignoring the fate of contemporary children living in manifest misery is acting inconsistently. Economic theory espousing sustainability cannot declare being incompetent for current distribution matters as it does for the last 100 years or so. It is interesting that – in Richard Howarth's words – "post-Brundtlandian" economists are rediscovering current distribution problems as matters of scientific inquiry after having adopted the principle of sustainability. So to speak, they needed the roundabout way via problems of intergenerational justice for rediscovering the intragenerational case.

## 5 Presentation by Prof. John E. Roemer

### 5.1 “Thoughts on intergenerational justice and sustainability”

#### 5.1.1 The maximin problem

Technical coefficients  $\{\alpha^t \mid t = 1, 2, \dots\}$

Utility function  $u(R, H)$

$H = \alpha^t I$ , forest growth rate  $\rho$

$$\max_{I(0), R(0)} \min_t u(R(t), \alpha^t I(t))$$

$$s.t. \quad R(t) = \rho R(t-1) - I(t), \quad t \geq 1$$

$$R(t) \geq 0 \text{ for all } t$$

#### 5.1.2 The leximin problem

Find  $R(\cdot)$  that solves  $P(n)$  for all  $n \geq 1$ , given  $R(0)$

$$P(n) \begin{cases} \max_{I(0), R(0)} \min_t u(R(t), \alpha^t I(t)) \\ s.t. \quad R(t) = \rho R(t-1) - I(t), \quad t \geq n \\ R(t) \geq 0 \text{ for all } t \geq n \end{cases}$$

**Proposition 1.** In a leximin solution, if an agent is constrained, then he consumes less housing than is individually optimal for him.

**Proposition 2.** If  $R$  is a leximin solution then:

1.  $\forall t \geq 1, u^t(R) \leq u^{t+1}(R)$
2. If for any  $t, u^t(R) < u^{t+1}(R)$  then agent  $t$  is unconstrained.

**Proposition 3.** Suppose that  $u$  is quasi-concave and no Indifference curve of  $u$  contains a segment of slope -1. Then there is a unique leximin solution.

**Definition.** The leximin solution exhibits *Nirvana* if every agent is unconstrained. (in particular, Nirvana holds if  $u^t < u^{t+1}$  for all  $t$ .)

Class 1.  $u^t < u^{t+1}$  for all  $t$

Class 2.  $u^t = u^{t+1}$  for all  $t$

Class 3.  $u^t \leq u^{t+1}$ , with equality for some  $t$  and inequality for some  $t$

A1. The rate of technical progress is constant for all  $t$ :

$$\frac{\alpha^{t+1}}{\alpha^t} = \gamma > 1, \text{ for all } t$$

A2. Cobb- Douglas preferences:

$$u(R, H) = R^\beta H^{1-\beta}$$

### 5.1.3 Theorem 1

A. If  $\gamma^{1-\beta} \leq \frac{1}{\beta\rho}$  then the leximin solution is defined

recursively by:

$$R^*(t) = \frac{\rho}{1+\delta} R^*(t-1), I^*(t) = \frac{\rho\delta}{1+\delta} R^*(t-1) \text{ where } \delta = \rho\gamma^{1-\beta} - 1$$

B. If  $\gamma^{1-\beta} > \frac{1}{\beta\rho}$  then the leximin solution is given by:

$$R^*(t) = \beta\rho R^*(t-1), I^*(t) = (1-\beta)\rho R^*(t-1)$$

There is Nirvana, and utilities increase at each date.

C. In case (A), the size of the forest decreases monotonically to a limit size of zero. In case (B), the size of the forest decreases to zero if  $\beta < \frac{1}{\rho}$  and increases to infinity if  $\beta > \frac{1}{\rho}$

### 5.1.4 Stone-Geary utility

$$A3. \quad u(R, H) = (R - x_0)^\beta H^{1-\beta}$$

$x_0$  is the amount of hiking that a person must have

### 5.1.5 Theorem 2 (assume A1 & A3)

A. If  $\beta\rho + (1-\beta)x_0 < 1$  then there is a unique TC process at which the leximin solution yields constant utilities and unconstrained agents at all dates. The size of the forest decreases over time to a limit value of  $\frac{x_0(1-\beta)}{1-\beta\rho}$

B. If  $\beta\rho + (1-\beta)x_0 < 1$  and TC is more rapid than in the above process then all agents are unconstrained in the leximin sol'n, utilities increase over time, and the forest approaches the same limit as in part A.

C. If  $\beta\rho + (1-\beta)x_0 > 1$  then under any process of TC, the leximin sol'n has agents unconstrained at every date, and utilities increase over time. If  $\beta\rho < 1$  then the size of the forest converges to the limit in A; if  $\beta\rho > 1$  then the size of the forest grows without bound.

### 5.1.6 CES utility, $r < 0$

**Theorem 3.** Let  $u(R, H) = (\beta R^r + (1 - \beta)H^r)^{1/r}$ . Let

$$p^t = \frac{1 - \beta}{\beta} (\alpha^t)^r, \quad \varphi(t) = \frac{(p^t)^{1/r-1}}{1 + (p^t)^{1/r-1}}$$

A. If the law of motion of TC is given by

$$\varphi(t+1) = \rho^{\frac{r}{1-r}} \varphi(t)^{\frac{1}{1-r}}$$

then we have Nirvana and constant utility. We have:

$$\lim \varphi(t) = \rho^{-1}, \quad \lim \alpha^t = \left(\frac{\beta}{1-\beta}\right)^{1/r} \left(\frac{\rho-1}{\rho}\right), \quad \text{and} \quad \lim \frac{R(t+1)}{R(t)} = 1.$$

B. If  $\alpha^t \rightarrow \infty$  then  $\varphi(t) \rightarrow 1$ . Eventually, on the leximin path, all agents optimize selfishly, utilities increase, and

$$\lim \frac{R(t+1)}{R(t)} = \rho.$$

In case B: Nirvana and Deep Green!

## **6 Presentation by Prof. Erling Steigum**

### **6.1 “Measuring Fiscal Policy Sustainability in a Resource-rich Economy: A Generational Accounting Approach”**

This section contains Prof. Steigum’s presentation in an abridged version concentrating primarily on Generational Accounting.

The presentation starts out with an overview of the Norwegian economy, the government’s petroleum wealth, the petroleum fund, and other assets before it comes to an analytical framework for intergenerational consumption smoothing. It then discusses fiscal policy implications of aging, the pay-as-you-go welfare state, and petroleum revenues. Furthermore, the instrument of Generational Accounting (GA) is presented as it is used in Norway. Two related topics are of special interest here: diminishing generational deficit and the problem of oil price risk. Finally, conclusions are drawn.

#### **6.1.1 Pitfalls for resource-dependent countries**

- The resource curse: Many resource-dependent countries show dismal growth performance (Sachs and Warner (1995,1999))
- Bad policies and the Dutch disease: Large public sectors and unsustainable fiscal policies
- Government spending too sensitive to the resource price: Resource boom and bust
- Low quality of political institutions appears to be important for understanding the resource curse.
- Examples of the resource curse: Venezuela, Nigeria, Algeria, Ecuador, Indonesia.

#### **6.1.2 The Norwegian economy in the 1970s: Building up the petroleum sector**

- Large petroleum investment and increasing revenues
- Positive terms-of-trade shocks (OPEC I and II)
- Excessive aggregate demand, negative real interest rates, wage explosion and strong real appreciation (the Dutch Disease)
- Inflationary economic policy, but postponement of unemployment
- Strong, but unsustainable economic growth. Structural policies attempting to prevent structural change.

### **6.1.3 Lessons from the policies of the 1970s and 1980s**

- Aggregate demand should be controlled to prevent fluctuations in the oil price to trigger boom-bust cycles
- Asymmetric shocks: Inflation targeting and a flexible exchange rate work better than a fixed exchange rate
- Strong populist pressure to increase government spending and the public sector. ("Since the government is so wealthy, why can't it hire more labour to solve..."). A good quality of the political debate is essential.
- A long-run fiscal policy strategy is important: Building up the Government Petroleum Fund
- The current account should be used to smooth consumption

### **6.1.4 The role of petroleum income in 2002**

- Norway is the third largest oil exporter in the world
- Mainland GDP is 78.8 % of Norway's GDP
- Petroleum exports are 43 % of total exports
- Net exports are 18.7 % of Mainland GDP
- Net cash flow to the government from the petroleum sector is 20 % of total government income and 14 % of Mainland GDP

### **6.1.5 Petroleum wealth and national accounts**

- The petroleum wealth does not appear in national and public accounts
- Traditional accounting of saving and wealth is misleading
- When the petroleum wealth declines, the national accounts overestimate income and saving.
- In the case of Norway, these problems are significant
- The generational accounting method deals with the petroleum wealth in a theoretically correct way.

### 6.1.6 Fiscal policy and the government's intertemporal budget constraint

- Let  $\Omega = \Omega^g + \Omega^p$ ,  $\Omega^g$  = the government's wealth (including the petroleum wealth),  $\Omega^p$  = private wealth,  $T$  = net taxes.
- Government asset accumulation:
- (8)  $\Delta\Omega^g = r\Omega^g + T - G$
- The intertemporal budget constraint becomes
- (9)  $PV_t(G) = (1 + r)\Omega_t^g + PV_t(T)(\text{government})$
- This constraint is the basis for generational accounting (below)
- The private sector intertemporal budget constraint follows from deducting (9) from (7):
- (10)  $PV_t(C) = (1 + r)\Omega_t^p + PV_t(wL - T)$  (private sector)

### 6.1.7 Present and future (unborn) generations

- We distinguish between present and future generations:
- (11)  $PV(C^{\text{present}}) + PV(C^{\text{future}}) = (1 + r)\Omega^p + PV(LW^{\text{present}} - T^{\text{present}}) + PV(LW^{\text{future}} - T^{\text{future}})$
- Assuming that the present generations consume the initial private wealth, we obtain
- (12)  $PV(C^{\text{future}}) = PV(LW^{\text{future}} - T^{\text{future}})$
- Therefore, future net taxes are crucial for future consumption and thus for intergenerational consumption smoothing
- Fiscal policy is also crucial for smoothing  $G$  over time.
- Generational accounting detects how well current fiscal policy smoothes the present values of  $G$  and  $T$  among generations.

### 6.1.8 Ricardian equivalence and the role of private intergenerational transfers

- If Ricardian equivalence holds, shifting lump-sum taxes among generations has no real effects.
- However, the tax system is distortive and tax rates should be smoothed over time to minimize the deadweight loss. Generational accounting is therefore still useful.
- When the government holds a risky petroleum wealth, households cannot easily treat it as a part of their private wealth, i.e. borrow to consume more now.

- In models with risk and precautionary saving, tax and transfer policy is likely to have strong real effects even if the present value of government expenditure is constant, and households are Ricardian.

### **6.1.9 Fiscal policy implications of aging and increased expected age-related spending**

- Expected aging and pay-as-you-go social security warrant accumulation of government wealth for the purpose of intergenerational consumption smoothing
- In most European countries, future pensions and health spending are expected to increase substantially
- In Norway, temporary petroleum revenues to the government represent an additional reason to accumulate a government petroleum fund.
- Also the tax rate smoothing argument calls for accumulation of government assets before the aging process and in response to temporary high petroleum revenues.

### **6.1.10 Generational accounting around the world**

- Generational accounting (GA): A method introduced by Auerbach, Gokhale and Kotlikoff (1991).
- GA permits a measurement of the departure from a sustainable fiscal policy, i.e. to what extent future fiscal adjustments will be necessary to satisfy the intertemporal budget constraint of the government.
- Adopted by many countries, see Auerbach, Kotlikoff and Leibfritz (1999) and Raffelhüschen (1999).
- First Norwegian study in 1993.
- Used by the Norwegian Ministry of Finance from 1994.

### **6.1.11 The basic budget constraint in GA**

- Using (9) and splitting  $PV(T)$  into the present values of net taxes of present and future generations:
- (13)  $PV(T^{\text{future}}) = -(1 + r)\Omega^g + PV(G) - PV(T^{\text{present}})$ .
- GA quantifies the terms on the RHS, assuming the present fiscal policy, as well as tax and transfer rules

- The LHS is determined residually and distributed among all future generations such that growth-adjusted net tax burdens (PV of net taxes at birth) are equal.
- To assess the generational balance, the PV of net taxes at birth for the youngest of the present generations (the newborns) is compared with the corresponding number for the first of the future (unborn) generations.

#### **6.1.12 Measuring the “generational deficit” in fiscal policy**

- Comparing PV of net taxes. Difficult to interpret.
- Calculating how much various tax rates must be increased now to establish full generational balance
- Calculate how much public consumption must be cut now, measured in percent of GDP.
- The latter has been preferred by the Ministry of Finance. It is easy to understand intuitively and to use for international comparison.

#### **6.1.13 Data requirements for GA**

- Assumptions about  $r$  and  $g$  (subject to sensitivity analysis)
- Population projection by age and sex
- Projections of different taxes, transfers and other spending by age and sex (age profiles)
- An estimate of the initial government wealth, including the petroleum wealth
- Projections of future government spending that is not distributed on age groups.

#### **6.1.14 Results for Norway**

- The 1993 study indicated a large generational deficit.
- The results were biased by active “Keynesian” fiscal policy to stimulate economic activity.
- During the 1990s, the deficit gradually declined.
- At the present, the deficit is small, but sensitive to assumptions about the interest rate and the petroleum wealth.
- A new project is underway to update the data

#### **6.1.15 What does generational balance mean for consumption smoothing?**

- The calculations assumes a constant growth rate ( $g$ ) of labour productivity and real wages

- The PV of net taxes of each newborn generation is 100g percent larger than for the previous generation
- The PV of after-net-tax labour income will also grow accordingly.
- The fiscal policy therefore supports a balanced growth path in which the growth rates of C and G are both g.
- The government must increase (B + W) accordingly, compare the growth-adjusted permanent income concept.
- This is not necessarily an optimal policy or what politicians want.
- The GA method is a way of measuring fiscal policy sustainability. It is not a normative theory about what current fiscal policy should be.

#### **6.1.16 The problem of precision**

- GA is sensitive to the business cycle in the base year. The budget deficit is strongly counter-cyclical.
- The measurement of fiscal sustainability with GA is sensitive to the assumptions about r.
- A higher r will reduce the generational deficit because the growth-adjusted permanent income from the petroleum wealth will increase.
- In countries with a large net public debt, a higher r usually will increase the generational deficit
- The oil price risk is huge. The projection of the future oil price probably involves an implicit risk adjustment.

#### **6.1.17 Should GA be risk-adjusted?**

- An unresolved issue in the literature
- According to the permanent income theory of consumption under uncertainty, if utility is quadratic, optimal consumption only depends on expected future income, not its variance (Hall, 1978). Then there is no precautionary saving.
- Precautionary saving is probably important empirically.
- If the government wants precautionary public saving, a risk-adjustment of the petroleum wealth is called for.

### **6.1.18 Conclusion**

- Generational accounting (GA) has been useful tool for the Norwegian government due to the particular importance of a long-run focus in fiscal policy.
- It is also useful in countries with large transfer programs financed on a pay-as-you-go basis (population aging), i.e. most European countries.
- The precision is fairly low and the issue of risk adjustment is unresolved.
- GA is not a substitute for, but a complement to building computable OLG models and other growth models to analyse alternative fiscal policy strategies.

## **7 Session II : “Intergenerational Justice and Fiscal Policy”**

### **7.1 Statement by Prof. Heinz Welsch**

#### **7.1.1 Concept of Sustainability**

- Sustainability is essentially an inter-temporal concept. However, sustainability may require (as a necessary condition) that temporal constraints (e.g. on inequality) be satisfied.
- Environmental sustainability is concerned with real assets. A common notion of environmental sustainability refers to a non-declining value of real assets (natural and produced capital).
- Fiscal sustainability is concerned with financial assets, i.e. debtor-creditor relations. It refers to non-increasing government indebtedness (relative to GDP)
- Environmental sustainability and fiscal sustainability are distinct issues. Fiscal sustainability can be captured by the state's intertemporal budget constraint. A formally similar constraint would in many cases not be meaningful with respect to environmental issues, as these often involve temporal constraints (upper bound on the stock of pollution or the rate of increase of pollution at any time).
- Nevertheless, environmental and fiscal sustainability can/must be studied jointly in certain cases. A particular case refers to natural resource rents that accrue to the state. Another case is ecological fiscal reform.

#### **7.1.2 Indicators of Fiscal Sustainability**

- The basis of fiscal sustainability indicators is the state's inter-temporal budget constraint. A non-increasing debt ratio then provides an appropriate conceptualisation of fiscal sustainability.
- An indicator of the size of the 'sustainability gap' is the increase in the net tax rate or the cut in government spending required to attain a non-increasing debt ratio.
- Calculating this indicator in the long term may require strong assumptions (growth rate, demographic development, interest rate etc.).

### 7.1.3 Assessment Tools

- Generational accounting can provide more detailed information than just the sustainability gap, as it attributes the required tax increase to different generations. The cost of this approach consists of even stronger informational requirements and assumptions.
- One crucial assumption is the absence of general equilibrium effects. These can be dealt with by “Overlapping Generation” (OLG) models.
- OLG models allow to study environmental and fiscal sustainability jointly within one unified framework.

## 7.2 Statement by Dr. Stefan Bayer

8. Generation Adjusted Discounting (GAD) (see Bayer 2003) is a discounting technique for evaluating public projects with intergenerational effects. By applying GAD we are able to judge the efficiency of long-term public projects taking into account distributional aspects as well.
9. The GAD differentiates between intra- and intergenerational discounting. (1) Intragenerationally, each individual is allowed to discount effects within its own lifetime as he/she wants to discount them. According to the Ramsey-rule, the generation specific discount rate can be calculated as sum of the pure time preference rate and the growth time preference rate. Irrational as well as rational reasons for discounting can be considered for. (2) Whenever the project-lifetime extends the individual’s lifetimes, we have to discount intergenerationally. Therefore, the pure time preference rate can-not be used due to the contradiction of the utilitarian requirement for equal treatment of all affected individuals. Distortions in favour or at the expense of specific individuals have to be prevented due to the utilitarian requirement for neutrality with regard to individuals. For intergenerational, social discounting solely the growth time preference rate can be used.
10. The separation of the “prescriptive” and the “descriptive” approach – as stressed by Arrow et al. (1996) - is avoided: Investment and consumption units are made comparable by calculating so-called “consumption equivalents” (or “shadow prices of capital”). Afterwards, the sum of investment and consumption effects can be discounted using time preference rates.

11. Let us have a look at an example of the GAD-effect compared to constant discounting until the end of the lifetime of an arbitrary project. For simplicity’s sake, we assume one single (consumption) effect of 400 which is available in 100, 200, and 300 years from now and determine the present value. We further assume a pure time preference rate and a growth time preference rate of 3%: Total discount rate 6%.

	t=100	t=200	t=300
PV(conventional discounting)	1.179	$3.47 \cdot 10^{-3}$	$1.024 \cdot 10^{-5}$
PV(GAD)	12.554	0.6532	0.03399
Difference	10.65	188	3,319

12. Employing GAD in intergenerational settings guarantees the fulfilment of intergenerational justice. The GAD can, furthermore, be interpreted as a discounting technique which fulfils intertemporal or intergenerational neutrality. On the other hand, each generation is allowed to discount effects within their lifetime according to their specific intertemporal preferences. Neither future generations discriminate against current living ones nor the opposite takes place.
13. Let us conclude: Taking the utilitarian requirement for equal treatment of all affected individuals seriously, we should apply GAD as discounting method whenever intergenerational effects have to be evaluated. All other discounting measures discriminate against future living individuals whenever equal income units are treated differently. Thus, the deduced statements with respect to sustainability are speculative. If we neglect the requirement for equal treatment of all affected individuals on the one side and determine sustainable outcomes with these methods on the other side, the resulting figures can only be called arbitrary.

### 7.3 Statement by Dipl.-Volksw. Christof Borgmann

#### 7.3.1 On Generational Accounting

Generational Accounting (GA) does not have a welfare economic foundation! It is solely a device of intertemporal budgeting in combination with the intertemporal budget constraint of

the government. One can interpret a notion of a “steady state equilibrium” into the method but basically it is a concept to measure to **fiscal sustainability**.

The **intertemporal budget constraint** says that the sum of all discounted future primary deficits has to equal today’s government wealth (or the other way around: current government debt has to equal the present value of all future primary surpluses). The time path of the future primary deficits is however not determined by the concept of sustainability.

The indeterminacy of the time path of primary deficits and sustainability already touches on the next question: **Are sustainability and equity intimately connected?** In practise and in the interpretation of the results of sustainability measurement this is often the case. But in theory sustainability may be a necessary condition for equity but it certainly is not sufficient.

### **7.3.2 On measuring fiscal sustainability:**

There are currently three approaches common in the literature on fiscal sustainability: Generational Accounting, the OECD (Blanchard) method, and econometric approaches. The notion of fiscal sustainability can already be found in Keynes (1923). It was Barro (1979) who first developed the representation of the intertemporal budget constraint s it is commonly used today, because he stated that before discussing consequences of public debt one should try to evaluate its path and the reason of its occurrence (one should remember this point when discussing whether bequest motives render fiscal sustainability measurements obsolete).

To start out with the last: The econometric approaches basically test whether certain fiscal variables are stationary. More precisely, a sufficient condition for fiscal sustainability is that surpluses (deficits) are stationary, which is equivalent to government debt following a unit roots process or a certain co-integrated relationship between debt and surpluses.

GA and the OECD approach are familiar in that they take future demographic developments into consideration. Future surpluses are predicted by age specific net taxes in combination with demographic projections. They differ in two points:

- which taxes and transfers are actually assumed to have an age-specific incidence and
- terminal condition, i.e. how far into the future one should look and what condition government debt must meet at the specified end of the projection (GA is theoretically consid-

eration an infinite horizon; in practise this is done by stopping after 200+ years and sometimes adding the infinite geometric series after this point).

### 7.3.3 Comment on sustainable tax rates: Convergence of the methods

Also: the specific equalizing burden experiment is connected with a normative choice of a scenario.

2nd point: comparing accounts under scenarios: apposite approach -> political economy?

Finally, people said that OLG comes close to GA. There is a lot of research that has to be done, but it is not highly rewarded in the scientific world. You cannot publish it. As to the interest rate discussion: we cannot leave out discounting completely.

### 7.3.4 Answers (or counter-questions) to the “Expert Questions”:

*Equity between generations and lifetime tax rates?* Should taxation be progressive in a dynamic context?

*Transferring the concept of generational accounting to environmental sustainability?* My first counter-question: What is the intertemporal budget constraint for the environment? Danger of returning to the “Club of Rome”!

*Equity to indicate sustainability?* If a situation of equal lifetime net taxes **for all future generations** is feasible (and considered as an indicator for equity), I would conjecture that this situation must coincide with sustainability. In the framework of GA this probably holds by definition. Also note, that such a state of the economic will also coincide with a steady state equilibrium in the sense of neoclassical growth theory. Thus, I come back to my preliminary remarks: the concept of sustainability underlying GA is much more a concept of equilibrium than one of equity.

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