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

Background paper for an expert workshop  
at the DIW Berlin

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# 1 Executive Summary

Substantial differences about the concept of sustainability arise not so much out of differences about the concept itself – “satisfying the needs of the present without compromising the ability of the future generations to meet its own needs” - but rather out of differences about normative and positive issues linked to this concept such as the means and the living conditions of future generations, the relevant subjects and objects of sustainability, and the treatment of uncertainty. To make headway in this discussion, this paper approaches sustainability from a perspective of theories of distributive justice as they are discussed by political philosophers. In doing so, we arrive at different issues in an intertemporal or, for convenience, “intergenerational” setting as compared to an “intragenerational” setting. The main issues encountered in the intragenerational setting are whether justice should be based on welfare or resources, and whether people can be held responsible for their preferences and individual circumstances of existence. Additional problems arise in an intergenerational setting. These are the problem of potentiality, the influence of the present on the future (population size, preferences, conditions of existence), and the fundamental uncertainty of future preferences and the future situations. No unanimous solutions to these problems exists among philosophers. However, the philosophical debate provides a useful guideline along which to discuss these issues. This is done in this paper with regard to the economic definitions of sustainability. While we find that the economic concepts of sustainability vary substantially and are largely incompatible with each other, they correspond surprisingly with different concepts of distributive justice, e.g. resource versus welfare based justice, or outcome-based versus procedural justice. However, the similarities are mainly to intragenerational theories of justice rather than to theories of intergenerational justice. The current economic debate on sustainability therefore ignores some crucial philosophical problems such as the problem of potential persons, the dependence of the future on actions of the present, and fundamental uncertainties. To advance the discussion on sustainability and (hopefully) arrive at a more powerful unified economic definition of the concept, it seems necessary to discuss some key questions. We found these mainly to be:

- Can equity between generations be used as a key indicator of sustainability?
- What is the appropriate *subject* of intergenerational equity; the individual, or generations, or ...?

- What is the appropriate *object* of intergenerational equity ; welfare, or resources, and which resources?
- What are the underlying assumptions about substitution processes, production possibilities, and ecological processes?
- Which obligations to future persons exist, and how far do they reach?
- For which preferences and which aspects of their situation should people be held responsible?
- Do we need economic models of endogenous preferences to tackle the problem of intergenerational equity?
- How do we deal with the uncertainty of future values and preferences?
- How do we deal with the uncertainty of the future situation?
- Can intra- and intergenerational justice be treated separately?

The second part of this paper is concerned with economic methods to measure intergenerational justice. Specifically, we discuss the methods of generational accounting and overlapping generation (OLG) models, both in a context of fiscal policy.

*Generational Accounting* is a method used to determine the effects of fiscal policy by age groups (and potentially other attributes such as gender) for the present and future generations. It aims to record who pays and when for all government expenditure, given that the government budget must be balanced at some point in time. This balancing constraint is somewhat similar to the OECD's concept of sustainable fiscal policy.

Generational Accounting applies two main indicators:

- *Generational accounts* show the real (i.e. inflation adjusted) net amount that each average member of a generation (calculated by age group) pays to the government during their remaining lifetime.
- *Lifetime net tax rate* is the total of taxes paid of a representative individual of an age group over his/her entire lifetime less transfers in the form of government payments relative to income.

The comparison of lifetime net tax rates between new-borns of different base years allows explicit consideration of issues of intergenerational justice.

There are two major theoretical objections to the methodology of generational account. The first questions the validity of the underlying lifecycle approach. The second criticises the incidence assumptions.

Within generational accounts, the planning horizon of individuals does not differ from their lifecycles. A planning horizon that reaches out over one generation's lifetime, or is much shorter than a life cycle, would substantially change the results gained with respect to a utility based interpretation of the accounts. This is the case, for example, if bequests are given from one generation to another. These bequests may completely offset intergenerational redistribution induced by government tax and transfer policy. Related to the lifecycle approach, the correctness of the budget constraint requirement within the accounts is questioned. In most generational accounts members of a present generation are not affected by this requirement. As a result, the burden of obtaining a balanced budget is shifted to future generations. This is why the new-borns generally face a much higher net tax burden than those of the base generation born one year earlier. The method also neglects to estimate the impacts of net tax burden on the quantities and prices of consumption and investment (incidence), and the repercussions on factor inputs in the production process (general equilibrium effects). To accurately assess tax or transfer incidence, a fully specified dynamic equilibrium model is necessary.

In addition to these theoretical objections, the generational accounting method has many empirical limitations. It relies heavily on long term projections of, for example, fertility rates, mortality, migration etc. These kinds of long term projections are, however, not specific to the generational accounting methodology; many other areas of research base their finding on such estimates. One of the most discussed parts of the accounts methodology is the discounting procedure; based on generational accounts for 23 European countries the standard discount rate in GA models is between 5 and 6 % given a real growth rate of approximately 1.5%.

Key questions to discuss on generational accounting are:

- Can the lifetime net tax rate be used as an indicator for equity between generations?
- If so, can equity between generations be used to indicate economic sustainability?

- If so, can the accounting procedure be adapted to gauge sustainability in other areas, e.g., environmental sustainability?

*Overlapping Generations (OLG) models* have been applied to study the consequences of an ecological tax reform. Assessing the long-term effects of such a tax reform requires the consideration of the structure of a given population. OLG models consider an age structure, in which several individuals of different generations live at a given point in time. Every individual is assumed to follow a life cycle from birth to death with its income depending on age. The assumed life cycle dependant income (and saving) allows to analyse the influence of the age structure on total savings and to assess the economic problems of aging.

OLG models are helpful instruments to analyse the distributional effects of long term-oriented strategies for sustainable development. They have not sought, however, to interpret sustainability in the broadest sense (ecological, economic and social). The models that we studied assume, for example, perfect competition on the labour market. This assumption is unrealistic for European economies and does not allow to analyse unemployment in different cohorts which - because of their different productivity. – are affected differently by fiscal policies.

Key questions to discuss on OLG models are:

- Can OLG models be used to assess the effect of fiscal policies on intergenerational equity?
- If so, can intergenerational equity be used to indicate economic sustainability?
- If so, can OLG models cover other aspects of sustainability?
- Are there methods for an economic measurement of intergenerational justice other than OLG models and Generational Accounting?

## 2 Introduction

The theoretical and methodological contribution of economics to sustainable development (SD) is inadequate. This is indicated, for example, by the fact that the concept of sustainable development is still rejected by many main stream neoclassical economists. In response, the merger-movement of “Ecological Economics” has formed which consists of many disparate scientific approaches, mainly tied by its frontier towards main stream neoclassical economics. This scientific divide is undesirable from a research policy point of view. Acknowledging this deficiency, the German Ministry of Education and Research (BMBF) is considering to fund a major research programme on „Sustainability and Economics“.

The BMBF is funding a DIW project that surveys economic approaches to sustainable development in a wide context of related scientific disciplines (general economics, social sciences, natural sciences). This survey aims to identify pressing research needs and promising lines of economic research that can bridge this gap and help overcome this scientific divide. It is based on an integrative concept, which we have labelled „Sustainability Economics“ (SE). The key features of SE 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) an identification of “bridges” between different economic “schools of thoughts” (e.g. neoclassical economics, ecological economics, evolutionary economics) by means of studying integration and disintegration processes in general science and exploring venues of interdisciplinary approaches (e.g. consilience).

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

This paper is a background paper to support the first workshop of this research programme on “Intergenerational Justice and Sustainability – Economic Theory and Measurement” which takes place on May, 15-16, 2003. This workshop departs from our finding that underlying many disputes on the concept of sustainability are some philosophical and ethical differences on the problem of intra- and intergenerational equity. It 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 this survey 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. We explain the basic methodology and discuss limitations and criticisms of these tools.

All workshop papers of this research programme 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 Concepts of Intergenerational Justice as a Foundation for an Economic Theory of Sustainable Development**

Global environmental problems such as climate change, the depletion of the ozone layer, or ocean pollution have rendered the assumption questionable that the future will always be better off than the present. Concerns that people in the future might not be as well off as those living today have led to the development of the concept of sustainability which aims at incorporating concerns about the future into present decisions. A well-known and widely accepted definition of sustainability is that of the Brundtland Commission. It defines sustainable development as development that “satisfies the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). However, the broad consensus that the Brundtland definition receives in both science and politics is mainly due to its imprecision. There exist a multitude of specialized definitions of sustainability that all refer to the basic Brundtland definition but differ substantially in both normative and positive aspects<sup>1</sup>. This has led to a situation where the concept of sustainability has become somewhat arbitrary, weakening its normative power. At the same time, the ongoing discussion seems to diversify rather than converge to one definition. Underlying this process are contrasting views about positive issues such as substitution possibilities, future technological possibilities, ecological processes, and about normative issues such as which obligations to future generations we have, how far they reach, and how uncertainty about the future should be treated. Common and Perrings express this problem by stating that

“Underlying many of the disputed issues is an ill-defined set of philosophical and ethical differences over the problem of both intra- and intergenerational equity. The net result is a debate in which the fundamental points at issue remain obscure.” (Common and Perrings 1992, 8).

In order to make headway in the discussion about sustainability and to give the concept more substance than it currently has, it seems useful to take a step back from the scene of definitions and to approach the issue from a broader perspective, in order to identify the key questions and the reasons for different views on these questions. From this generalized perspective, we find that sustainability has much in common with distributional problems as they have been analysed by political philosophers. We therefore give a brief overview of the theories of

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<sup>1</sup> See Pezzey (1992). For a critical discussion of the indeterminateness of the notion of sustainability, see Jacobs (1999).

distributive justice that are currently discussed in political philosophy, as well as an overview of economic definitions of sustainability. Besides presenting the concepts, we work out their underlying assumptions and how they tackle the key problems faced by a definition of sustainability, i.e. who is the subject of sustainability (the individual or the generation), what is the object of sustainability (welfare or resource), which obligations exist to future generations and how do we deal with uncertain future preferences and livelihoods.

For didactical reasons we start with a discussion of most important contemporary views on distributive justice in an intragenerational setting, which are followed by a discussion of the specifics of intergenerational justice<sup>2</sup>.

### 3.1 Sustainability as Distributive Justice

There are many different definitions of sustainability (see, e.g., Pezzey 1992). Most of them share the notion that future generations should not be worse off than people living today. Underlying these definitions is the premise that all people, present and future, have the same right to a decent life, and the question posed by sustainability is how to allocate resources in a way to guarantee this basic right. To answer this question, it is useful to disregard the specifics of intergenerational justice and to look at general theories of distributive justice as they are discussed by political philosophers (see table 1 for an overview).

**Table 1: Theories of Distributive Justice**

Theories of Distributive Justice			
Outcome-based Justice			Procedural Justice
<i>Welfare based</i>		<i>Resource based</i>	<i>Libertarian Theories</i>
Utilitarianism	Welfarism		
<i>Egalitarian Theories</i>			Concept of Fairness (~“envy freeness”)
Equality of Welfare	Equality of Opportunities	Equality of Resources	

<sup>2</sup> For a critical assessment of problems arising from the separate treatment of intra- and intertemporal justice see, e.g., Auerbach (1995).

### 3.1.1 Utilitarianism

A concept of distributive justice that has been widely discussed in political philosophy and in economics is that of utilitarianism<sup>3</sup>. Utilitarians assume that the well-being of an individual can be expressed in a single unit, utility, which can be objectively measured and is thus comparable between individuals (Yaari 1981). They argue that justice requires treating people as equals, and that this requires giving each person the same weight in the social calculus. Scarce goods should be allocated so as to maximize the sum of individual utilities<sup>4</sup>. This concept has the advantage of being consensual (Pareto optimal) and easily integrable into economic models. A number of criticisms against utilitarianism have been raised, however.

The first criticism concerns the use of utility as a measure of people's well-being. It has been argued that utility does not include all relevant elements for a theory of justice such as concern for others or differing opportunities, and that the implied abstraction from the causes of happiness renders a utility based concept unsuitable for normative considerations. The first critique can be met by the modern view that utility is nothing else than the representation of people's preferences and thus includes anything that matters to individuals, including the above mentioned concerns (Roemer 1996). The second point poses a more serious challenge to utilitarianism. Goods have different moral weight, and people have different needs, and goods may be put to different uses. Thus the consumption of champagne might be considered different than that of milk for considerations of justice, even if they cause the same amount of utility. Similarly, the consumption of milk for feeding a hungry baby might be considered morally different than that for feeding an over-fat cat, and some individual tastes, like obtaining pleasure from torturing other people, must be rejected from a moral stand point<sup>5</sup>. All these differences are indistinguishable in the utilitarian theory.

Another criticism of utilitarianism concerns the assumption of measurability and comparability of utility. Happiness in a utilitarian sense has to be cardinally measurable and the utility of individuals has to be unit comparable.

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<sup>3</sup> See, e.g., Harsanyi (1953, 1955).

<sup>4</sup> In most utilitarian studies, the number of individuals is taken as constant. A varying population size introduces the additional problem of determining the optimal population size, which is not independent of the resource base and its division. We discuss this point in Section 3.

<sup>5</sup> The problems of "expansive tastes" are elaborated by Sen (1987); examples are taken from Roemer (1996).

The summation of individual utilities that is done in utilitarianism also causes a number of problems for a theory of justice. The existence of different needs, e.g., due to different talents of people or to the existence of individual handicaps, renders giving each person the same weight in determining social welfare questionable for a theory of justice (Rawls 1971). The summation also implies that the utility of one person is traded off with that of any other person<sup>6</sup>. Summing up individual utilities can also cause morally unappealing results, e.g., if the maximum of total utility corresponds to a situation in which some part of the population is deprived of basic rights, e.g., enslaved. This is possible since with large numbers of individuals, the utilitarian prescription is in most cases insensitive to the well-being of the single individual.

Some of these criticisms can be met by modifying the concept of utilitarianism, e.g., by using a weighted sum of utilities and choosing the weights according to ethical considerations. However, this needs an ethical concept for determining the weights, i.e. an outside theory of justice.

### **3.1.2 Welfarism**

Some of the criticism of the utilitarian approach has led to the development of the more general concept of welfarism. In this concept, the maximization of the sum of individual utilities is replaced by the maximization of a more general function of the individual utilities. To the utilities  $u_1(x_1) \dots, u_n(x_n)$  of the individuals a so-called social welfare function  $W(u_1(x_1) \dots, u_n(x_n))$  is specified, which is then maximized to obtain the just allocation of goods in society.

Welfarism meets some of the criticisms of utilitarianism, but it fails as a criterion of justice if a person's capability to generate utility is very limited due to reasons beyond his/her control. Furthermore, since in welfarism people are compensated for their preferences, the problem of expensive tastes remains. Also, individually different needs or talents are not necessarily considered in the determination of the distribution, and, like its utilitarian forerunner, the theory does not grant a minimum level of welfare to the individual.

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<sup>6</sup> See, e.g., Rawls (1971).

### 3.1.3 The Egalitarian Approach

A number of modern theories of justice hold the view that justice requires some kind of egalitarianism. Egalitarian theories can be divided into theories advocating equality of welfare and theories advocating equality of resources. We discuss these in turn.

#### 3.1.3.1 Equality of Welfare

The egalitarian concept closest to utilitarianism is that of equality of welfare, which holds that the just distribution of resources is that which equalizes welfare among individuals. In contrast to the utilitarian approach, which maximizes an aggregate of individual utilities, the theory of equality of welfare is based on the individual. The postulated equity of individuals enters through granting them equal welfare. The argument for choosing welfare as the equalisandum is that goods or resources are valuable to people only because they produce happiness, and a theory of justice should be concerned with distributing what ultimately matters to people, not with anything which has only instrumental value<sup>7</sup>.

The concept of equality of welfare has been criticized by a number of authors<sup>8</sup>. Since it is a welfarist concept, the criticisms concerning the sole use of utility as a criterion for justice remain valid. Thus Dworkin (1981a) rejects equalizing welfare because it implies giving more resources to those with expensive tastes. A similar argument can be made for the problem of “cheap tastes<sup>9</sup>. According to Sen (1987), justice requires giving these persons more resources than they claim.

Next to the responsibility for preferences, differing talents constitute a central point in the debate about the right equalisandum. Equalizing welfare does not take into account the individual’s contribution to the generation of welfare. Equalizing welfare independently of the individual’s contribution will lead either to an inefficient state where nobody has an incentive to generate welfare, or to a situation of the „slavery of the talented“, where efficiency demands that the individuals with high talents devote all their capacities to generating welfare that is then distributed equally among all individuals, including those who contributed little or nothing to its generation.

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<sup>7</sup> See Dworkin (1981a).

<sup>8</sup> See, e.g., Rawls (1971), Dworkin (1981a), and Scanlon (1986).

### 3.1.3.2 Equality of Resources

Equality of welfare has been contrasted by Dworkin's concept of equality of resources. Dworkin (1981a,b) argues that the right equalisandum is resources, where compensations have to be made for certain nontransferable resources such as individual talents. As a method of finding a just distribution Dworkin proposes an insurance scheme. In this scheme, the individuals know their preferences and the probability of being born with a certain bundle of non-transferable resources. They are supplied with an equal amount of transferable resources and can take insurance against the risk of being born with a certain amount of non transferable resources. The just distribution is that which would arise in this setting.

The theory of equality of resources has been criticized in several respects. One criticism is that justice should be concerned with what ultimately matters to people rather than focus on merely instrumental goods (Arneson, 1997, 237). Other political philosophers like Rawls (1971) and Sen (1980) hold that resources are the appropriate base, but that there are different kinds of resources that are of varying importance for a theory of justice. Rawls (1971) holds that, despite individual tastes for goods, there are certain basic goods that all people would rather have more of than less. Examples are basic liberties such as the right to move freely, to choose a profession, or the possibility to participate in society. These so-called „primary goods“ constitute the equalisandum which a theory of justice should be concerned with. Rawls then shows that maximizing the welfare of the worst-off individual with respect to resources is the allocation rule that impartial individuals would agree on if they were to choose an allocation rule. Sen (1980, 1999) holds that not the goods themselves are important, but what these goods can do for people, i.e., their „functionings“. E.g., the functioning of bread is to provide nourishment, the functioning of a bicycle is to provide transportation, or the functioning of a democratic election is to enable people to participate in the decision making. What should be equalized is the vector of functionings available to each person.

Thus all theories advocating equality of resources hold that what should be equalized between individuals are certain resources, since these constitute the inputs into a meaningful life; but the theories differ in what the relevant resources are, which leads to considerable differences in what is considered a just distribution.

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<sup>9</sup> Individuals to whom this problem applies have, due to circumstances beyond their control, adopted preferences that are too modest.

### **3.1.3.3 Equality of Opportunity for Welfare**

Cohen (1989) and Arneson (1990) argue that granting people the resources necessary to lead a meaningful life is not enough, but that the welfare a person can derive from these resources needs to be taken into account explicitly. What should be equalized is neither welfare nor resources, but a combination of these concepts. Cohen and Arneson return to the position that welfare should be at the centre of a theory of justice but, taking up Dworkin's idea that individual responsibility should be taken into account, they argue that what should be equalized are those aspects of their situation that people are not responsible for, so that everyone has an equal opportunity for welfare.

### **3.1.4 Libertarian Theories**

The existence of differing ideas of a good life and the resulting differences in the need of resources have led some political philosophers to conclude that a theory of justice should not attempt to grant people a certain outcome. The aim should rather be to grant a setting in which each individual can pursue his/her interests to the greatest extent that is compatible with the same right for others<sup>10</sup>. Thus, libertarian theories of justice centre not on the justness of outcomes, but on shaping a just procedure for the distribution of goods or resources. Also, the freedom of the individual from external interference is an important point in these theories. We briefly discuss the theories of Nozick (1974) and Gauthier (1986), as well as the concept of fairness.

#### **3.1.4.1 The Procedural Theory of Nozick**

In contrast to the theories discussed so far, the theory of Nozick (1974) is a purely procedural one: the justness of a distribution depends solely on how it came to be. A distribution is defined as just if it has arisen through just transactions, starting from a just initial distribution. As a libertarian theory, Nozick's theory is based on the assumption of self-ownership, i.e., persons have the moral right to use their talents and their position to benefit themselves, as long as they do not harm others (Nozick 1974).

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<sup>10</sup> The question of how the relations between individuals should be shaped so as to grant each individual the greatest possible freedom compatible with the same right for each other individual has, e.g., been investigated by Kant (see Rosen 1993) and Rawls (1971).

As a theory of justice, Nozick's theory has several shortcomings. First, it needs a just initial distribution to decide if a given distribution is just. This poses the questions according to what criterion the justness of the initial distribution is determined and whether such a just distribution can be found in existing societies. Second, the same distribution may be just or unjust, depending on its history. This has been criticized as being artificial (Roemer 1996). Also, the just initial distribution may in time evolve to a very unequal distribution. Finally, the assumption of self-ownership has been criticized as being arbitrary and morally not defensible (Gibbard 1976; Cohen 1995).

#### **3.1.4.2 The Contractarian Theory of Gauthier**

Another libertarian theory is the theory of Gauthier (1986). Gauthier attempts to derive a theory of justice without resorting to an external morality. In his view, justice is the outcome of a bargaining process between rational, self-owning individuals in a situation of perfect competition.

Gauthier's theory has provoked a number of criticisms. The most important one is that individuals will have differing bargaining power, owing to their talents and the initial distribution of resources. Another point is that it is unclear how a just initial distribution of resources can be established, and that individuals who have little to offer are badly off in the bargaining process. A second important criticism concerns that Gauthier cannot convincingly explain why individuals should comply with the agreements made during the bargaining process (Gauthier and Sugden, 1993).

#### **3.1.4.3 The Concept of Fairness**

The concept of fairness combines considerations of procedural justice and distributive justice. It has been defined by Foley (1967) and by Schmeidler and Yaari (unpublished paper) as an allocation that is "envy-free", i.e., no individual prefers another individual's bundle of goods to his/her own. While there are some doubts among political philosophers if fairness is an acceptable theory of justice (Rawls, 1971; Roemer, 1996), the concept has gained much popularity in economics since it integrates well into economic methodology and avoids the problems inherent in interpersonal comparisons of well-being. Fairness limits a distribution to be close to that of a welfare egalitarian one. However, the concept has several shortcomings as a criterion of justice. Thus it has been questioned if taking only preferences and amounts of goods into account is sufficient for a theory of justice, and if a meaningful comparison of

well-being is possible without interpersonal comparisons. Furthermore, the concept imposes strong informational requirements on the individuals (Pazner 1977). Also, there is no compensation for different needs or different talents of individuals<sup>11</sup>, which may lead to allocations that seem questionable to be termed just, the problem of cheap tastes remains, and allocations that are both envy-free and Pareto optimal do not always exist in production economies (Pazner and Schmeidler 1974).

### 3.1.5 Main Points: Distributive Justice

Modern theories of justice regard individuals as equals but differ considerably with regard to the meaning of equality. They also differ on what should be allocated, and which distributional principle should be used. The main points emerging from our debate on intragenerational justice are:

- Does the single individual matter for justice, or are only aggregates such as generations relevant?
- How far should differences between individuals be compensated, i.e., how far should individuals be responsible for their needs, preferences, talents and livelihoods?
- How do the requirements of justice compare with the freedom of the individual, and how are these goals to be weighed in case of conflict?
- How far should the varying importance and moral values of goods be taken into account?

The key differences between distributional theories based on welfare and those based on resources are listed in table 2:

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<sup>11</sup> Some variations of the concept of fairness have been developed to deal with nontransferable goods such as a person's time or differing abilities, see Varian (1975) or Pazner (1977) for an overview.

**Table 2: Welfare versus Resource Based Justice**

	<b>Welfare</b>	<b>Resources</b>
Object of justice	Welfare is what ultimately matters, goods have only instrumental value	Welfare is problematic, therefore use resources as the object of justice
Possibility to account for moral differences in goods	Varying importance and moral value of goods not taken into account	Possibility to account for differing importance and moral value of goods
Responsibility	Full compensation for preferences and situation (-> problem of “cheap” and “expensive” tastes)	Full responsibility for preferences and situation
Informational requirements	High informational requirements (goods -> utility, measurability and comparability of utility)	Few informational requirements but high requirements on aggregability of goods
Incentive problems	Incentive problems (revelation of preferences, generation of welfare)	

In the intergenerational case also:

Separation of intra- and intergenerational justice	Intra- and intergenerational justice cannot be treated separately <sup>12</sup>	Intra- and intergenerational justice can be treated separately
Dealing with uncertain future preferences	Problem that future preferences are unknown	Present „dictates“ which resources matter
Further problems		Future generations are held responsible for things outside their control

### 3.2 Specifics of Intergenerational Justice

Since sustainability is concerned with the allocation between present and future generations, it requires an explicit theory of intertemporal or intergenerational justice<sup>13</sup>. This introduces a number of difficulties not present in the intragenerational case presented so far. There are three main problems of intergenerational considerations: the problem of potentiality, the influence of the present on the future, and uncertainty.

<sup>12</sup> The social welfare depends on the individual welfares, which are dependent on the distribution within the society.

<sup>13</sup> For convenience we use the terms intertemporal justice and intergenerational justice interchangeably in this paper, although we acknowledge that there are some subtle, important differences between these terms with regard to the subject of justice.

### 3.2.1 The Problem of Potential Persons

If we are concerned with the rights of individuals in future generations, we are talking about a group of people not yet born; out of an almost infinite number of imaginable individuals with different talents and preferences („potential persons“). Only some will come into existence, depending on the realization of circumstances. So there are two qualitatively different kinds of people in problems of intergenerational justice, actual persons, who already exist, and potential persons, who will perhaps at some point exist or perhaps never exist. For justice, this poses two questions. First, are there obligations to potential persons at all, and second, how do these obligations differ from those to actual persons. This is referred to as the problem of potentiality which has been much discussed in the philosophical literature<sup>14</sup>.

There are two basic positions concerning the existence of obligations to future persons, the relationalist and the universalistic position. The relationalist position derives obligations solely from the relation to the persons concerned, arising out of shared values and circumstances of life. But this means that, in the very long horizons of sustainability issues, almost no obligations to future generations would exist<sup>15</sup>, except maybe for an obligation not to deliberately harm these distant groups of people. This position is untenable, however, if one is concerned with sustainability since the interests of our immediate descendants and distant future generations will most probably not coincide.

A more appropriate view for the definition of sustainability is the universalistic view. This holds that there are universal principles that apply to all people, irrespective of the time of their birth. In the context of intergenerational justice, this means that potential people have the moral right that their needs and desires be considered in the same way that the needs and desires of present people are<sup>16</sup>. However, there exist morally relevant reasons to differentiate between actual and potential persons<sup>17</sup>. But this difference do not justify discounting. In fact,

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<sup>14</sup> See, e.g., the essays in Sikora and Barry, eds (1978), especially Warren (1978), Anglin (1978), and Sikora (1978), as well as the discussion in Auerbach (1995).

<sup>15</sup> Since the provision of well-being for children and grandchildren is shared by a number of other persons (this number is the larger the more distant the child is from the provider), this creates a positive externality which results in the underprovision of well-being, which refutes the argument that well-being can be provided solely by a „chain of obligations“.

<sup>16</sup> Focusing on needs, this is exactly what the Brundtland definition of sustainability says.

<sup>17</sup> Dasgupta (1998) argues this in an example of a choice between granting resources to a living child or to conceive another child and grant the resources to this child. Both children will enjoy the same level of welfare, in the second case the welfare of the already existing child will be zero. This example shows that in a case whe-

the difference between actual and potential persons is only a difference between present and future persons in the large, whereas there is no ethical difference between future persons living in let's say in 50 or in 5000 years.

### **3.2.2 The Influence of Present Actions on Future Individuals**

The number and the identity of individuals plays an important role in deciding questions of distributional justice. A key difference between the intragenerational and the intergenerational contest arises from the fact that these are not determined for the latter at the time of the decision making. Since questions of distribution are not independent of the number between which must be distributed, this raises the question of the optimal population size<sup>18</sup>, and the question who should be responsible for the numbers. There exists the tendency among philosophers to hold people only responsible for circumstances within their control, which would mean that future people should not be responsible for their population size, since this is determined by the preceding generation. On the other hand, as Barry (1997, 107) argues, if the world population continues to increase at its present rate, providing equal standards of living for future people would place an unjustifiable burden on present individuals. He therefore suggests viewing sustainability concerns under the assumption of current population levels. Another view is to say that for sustainability, each generation has to provide the adequate means for the population size it determines.

Another point of influence of present action on future people is the influence on preferences and talents. What is regarded as a decent life is to some extent influenced by former individuals through cultural and social transmission. E.g., the desire to have one's own car to move around in, or , say , to eat vegetarian meals. But this raises the question why or to what extent future people should be held responsible for the so acquired preferences, and for the inherited talents and needs. Does, for example, the genetical transmission of diseases like diabetes, or the creation of new health hazards through pollution, require compensation in the form of an augmented resource base? There is also the theoretical argument of the strategic use of this influence in the form of voluntary extinction and the strategic manipulation of preferences. Consider the following problem<sup>19</sup>: A society consisting of 100 persons commands over a

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where resources are scarce, the welfare of an existing person has moral precedence over that which can be created if a potential person is brought into existence.

<sup>18</sup> See Dasgupta (1998).

<sup>19</sup> Example taken from Auerbach (1995).

fixed amount of renewable resource whose maximum sustainable yield is 100 units per time period. This yield is to be distributed intra- and intergenerationally according to the resource egalitarian criterion that all should have an equal amount of that yield. Consequently, each person would get one unit per period. Now consider a society that wants to use 110 units, whereby it would reduce the maximum sustainable yield to 90 units for all future periods. To compensate for this, the society reduces the number of future persons to 90, so that each future person has one unit per time period. If this practice of taking 10 per cent more and in turn reducing the number of future persons by ten per cent is followed by each generation it will eventually lead to the extinction of the society. Neither present nor future persons are harmed, and all individuals have a higher consumption per head than under a policy of constant population.

Even more visible than the influence on future people is the influence of present actions on future livelihoods. The future situation in practically all its aspects is largely determined by present actions such as resource use, population size, technological possibilities, hazardous wastes, legal and institutional setting, and knowledge. This “heritage” clearly raises the question for which aspects of their situation future people can be held responsible.

### 3.2.3 Uncertainty

Fundamental uncertainty about the future will always exist: neither the number of individuals, nor their preferences, nor the impacts of an action on the future can be determined with certainty at the time when decisions about present actions have to be taken. This problem is substantial. Under uncertainty, the welfare of future persons cannot be assessed; in general, both the environmental, economic, and social situation in the future and the welfare future persons can gain from it are uncertain. Thus a welfare comparison, which is basic to most intragenerational concepts of justice and to a lot of sustainability concepts, is severely hindered<sup>20</sup>. However, uncertainty is a problem that is not well studied in the literature on intergenerational justice, and a fully satisfying solution has not yet been found. In the following, we present three approaches that span a wide range of views on how uncertainty affects the issue of intergenerational distribution. The first approach is to regard the uncertainties involved as so funda-

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<sup>20</sup> This is aggravated by the fact that the attitude towards risk may change over time. Even if the present could agree on a risk-neutral criterion, like the conditional expectation, future persons may evaluate risky situations on a worst-case basis.

mental that almost no obligations exist to consider the needs of future persons. As we have argued in the section on potentiality, this approach is not compatible with the idea of sustainability. The second approach is to consider the well-being of future individuals, but to give it a lower weight in the distributional calculus than that of present persons, in order to account for the uncertainty. Mostly this weighing is done by discounting. This approach is predominant in economics but rather problematic from a methodological, as well as from a philosophical point of view. We discuss discounting in the subsequent section. The third approach handles uncertainty directly by using probabilities instead of realizations. In this approach, future persons are not granted a certain outcome, but a probability distribution over outcomes. The normative appeal of this concept is that individuals at all times are treated equally with respect to uncertainty, and that the responsibility for actions taken is distributed according to the influence these actions have on future risks and chances. But the problem remains how to determine the weights of the possibilities especially when catastrophic risks are involved. Altogether, uncertainty is a substantial and still largely unresolved problem in defining intergenerational justice.

### **3.2.4 Discounting**

It is common practice in economics to discount future events. The main reasons given for discounting are uncertainty, pure time preference, and that future generations will be better off than the present one<sup>21</sup>. The discount rate is derived either from ethical principles that give a guideline how to weigh the well-being of different generations, or it is derived from observations of the rate of return to capital for various assets (e.g., Portney and Weyant 1999). While there is little controversy about discounting for time spans of about 40 years into the future, discounting the far distant future is the base of much controversy, and many economists have an uneasy feeling about discounting events in the distant or far distant future (e.g., Weitzman 1998, Chichilinsky 1996, Heal 1997).

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<sup>21</sup> For an overview see Hampicke 1991, Portney/Weyant 1999, Bayer 2003 and other contributions in the special issue of the *International Journal of Sustainable Development* Vol. 6 (1) on discounting.

There are two kinds of problems involved in discounting, methodological and philosophical ones. The methodological problem concerns the derivation of a discount rate. It is methodologically difficult, if not impossible, to quantify the uncertainty of future preferences and of the outcomes of present actions. Extrapolating past rates of return to capital is not a sound solution because

„behind the far distant future interest rate is the long run productivity of capital, which depends on a host of factors unknowable at the present time. There are fundamental uncertainties about the rate of economic growth, the amount of capital that will be accumulated, the degree of diminishing returns, the state of the environment, the state of international relations, the level and pace of technological progress, the rate of pure time preference, the degree of substitutability of accumulable and nonaccumulable factors, and all of the many other economic and noneconomic features that might be relevant to determining the distant-future own rate of return on consumption.“ (Weitzman 1998, 203).

In addition, empirical observations show that individual discount rates depend on factors such as the magnitude and sign of what is discounted, the time until the event will take place, framing effects, and the feelings that are associated with the future event (Loewenstein and Thaler 1989). It has also been observed that people do not discount distant events exponentially but rather use declining rates of interest (Weitzman 1998). There are a number of studies that argue that the appropriate discount rate for distant future problems should be zero (Broome 1992, Cline 1992) or that it should be declining from today's to a rate close to zero (Weitzman 1998). Gollier (1999, 2000) finds an inverse relationship between the long run discount rate and the time horizon. However, results in this field vary, and one can find justifications for discount rates „at or near zero, as high as 20 % and any and all values in between“ (Portland and Weyant 1999, 4). This is a serious deficiency since small differences in the discount rate amount to very large differences in the long run. So how do these large differences in the discount rates arise? Again the core problem are ethical ones.

The basic ethical question is whether discounting is an acceptable practice in long-term problems like sustainability, and the answer is, quite clearly, no, although there may be well-

founded reasons to weigh future people less than present ones in certain circumstances<sup>22</sup>. This point is expressed, e.g., in Chichilinsky (1996, 235):

„[D]iscounting future utility is generally inconsistent with sustainable development. It can produce outcomes which seem patently unjust to later generations. Indeed, under any positive discount rate, the long-run future is deemed irrelevant.“<sup>23</sup>

As an example, „one should spend no more than 20 cents today to eliminate a one-million damage happening 200 years from now if one uses a discount rate of 8 %" (Gollier, 1999, 1). So, one philosophical argument against discounting in long-term problems is that the future does not much matter under an exponential discount rate. Deducing discounting from the existence of uncertainty is also morally questionable. Indeed, it requires a risk-averse rule of justice<sup>24</sup>. It can be observed that individuals behave risk-averse, but this does not justify a risk-averse intergenerational distribution rule, since the latter affects different individuals and would result in discriminating individuals with respect to the time of their birth, which is random and morally unacceptable<sup>25</sup>. Indeed, any positive discount rate in the social calculus gives the present a dictatorial position in the intergenerational allocation (see Chichilinsky 1996 and Chichilinsky et al. 1995).

To sum up, there are fundamental ethical questions involved in discounting the long run. For long-term problems like sustainability, discounting seems a questionable strategy, because the many uncertainties of the future render finding an appropriate discount rate impossible, because it discriminates between people for non-moral reasons and mainly because under an exponential discount rate the long run future becomes irrelevant.

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<sup>22</sup> However, although many people are troubled by discounting, a lot of people suggest weighing future benefits and costs with some positive discount rate, see Portney and Weyant (1999).

<sup>23</sup> Weitzman (1998) and Gollier (1999) provide similar arguments.

<sup>24</sup> A risk-neutral rule would use the conditional expectation of the uncertain variables implied by the available information, which implies no discounting.

<sup>25</sup> The argument that discounting is ethically unacceptable if there are different people involved can also be found in Hampicke (1991).

### 3.2.5 Main Points: Intergenerational Justice

The main points from the debate about intergenerational justice can be summarized as follows:

- There is a qualitative difference between currently living and future people.
- This difference justifies a different treatment of present and future people even if sustainability ethically grants them an equal status. However, this different treatment must be morally well grounded and does not justify discounting as it is frequently practiced.
- Exponential discounting renders the long run future irrelevant.
- Present actions influence future situations and the criteria by which they are evaluated.
- Fundamental uncertainty exists about the values and preferences of future people.
- Fundamental uncertainty exists about the future situation, e.g., about the population size, technological possibilities, or the outcome of ecological processes.

### 3.3 Economic Definitions of Sustainability

We now return to an environmental economic setting, where questions of intergenerational justice occur in the debate about sustainability<sup>26</sup>. Like the theories of justice discussed in Section 3.1, they can be divided into welfare based and resource based approaches.

#### 3.3.1 Welfare Based Concepts of Sustainability

One group of definitions of sustainability are based on welfare considerations. The most prominent of these definitions is that of sustainability as non-declining welfare<sup>27</sup>. An example of this approach is the definition of Pezzey (1997), who sees sustainability as a constraint on the intergenerational distribution, “in a context which ignores uncertainty, environmental, and intratemporal concerns” (Pezzey, 1997, 448). He distinguishes between sustainable, sustained, and survivable development and shows that these constraints can conflict with maximizing the present value of utility. His framework is that of an infinitely living representative individual with constant preferences and full information about the future of the economy. The

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<sup>26</sup> An overview of sustainability concepts can, e.g., be found in Toman et al. (1995), which centers primarily on the neoclassical perspective, and in Pezzey (1992). A discussion from an applied point of view can be found in Munasinghe and Shearer, eds (1995).

population is assumed to be constant, and the utility of the representative individual depends only on the current consumption. A utility path is called sustainable if the utility in each period  $t$  is below or equal to “the maximum utility level which can be held forever constant from time  $t$  onwards, given the state of the economy’s productive resources at  $t$ .”<sup>28</sup> Thus an economy is sustainable if the utility of the representative individual is non-declining over time.

Another welfare based approach is that taken by Chichilinsky (1996, 1997). Chichilinsky views the problem of sustainability as a social choice problem<sup>29</sup>. Each generation has preferences over alternative developments of the economy, and the social choice problem is to combine these differing preferences in a way that respects certain ethical principles, which are formalized in the axioms of “non-dictatorship of the present” and “non-dictatorship of the future”. She then looks for a criterion that ranks possible development paths. The idea of sustainability in this approach is captured in the requirement that no generation, or, more precisely, no group of generations, should have an over large influence on the development of the economy. This approach leads to a social choice criterion that is the weighted sum of two parts. The first part is a discounted integral of utilities and represents the interests of the present; the second part depends on the long-run properties of the utility stream and represents the interests of the distant future.

A third approach from the area of social choice is that of Asheim et al. (2001), who derive a justification of sustainability from the ethical axioms of efficiency and equity and formulate a sustainability constraint that requires the envy-freeness of all future generations. In this setting, they then investigate the relation between sustainability and efficiency, as well as the influence of uncertainty on sustainable policies.

Another welfare based approach is that of sustainability as envy-freeness, as discussed in Woodward (2000). Woodward defines the decisions of a generation as sustainable if it does not expect to be envied by future generations. To this end, he develops a discrete model where the utility of each generation depends on its resource stock, the choices made by the generation, and a vector of stochastic shocks representing uncertainty. He then solves an optimisation problem that has intra- and intergenerational feasibility as constraints.

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<sup>27</sup> A discussion of this approach, as well as further references, can be found in Acker-Widmaier (1999). Criticisms of this approach can, e.g., be found in Beckerman (1999) and Norton (1999).

### 3.3.2 Resource Based Concepts of Sustainability

Another group of definitions are resource based. Similarly to the non-declining welfare approach, this group defines sustainability as non-declining capital stock, where the definitions differ in the question which notion of capital should be maintained<sup>30</sup>.

The concept of “weak sustainability” uses an aggregated capital stock that comprises natural and produced capital<sup>31</sup>. It defines an economy as sustainable if this aggregated capital stock is non-declining. Thus a development that is based on the depletion of a finite amount of natural capital is sustainable if there exist substitutes for the natural capital and the investment in these substitutes at least compensates for the loss of natural capital. Solow (1974, 1986) and Hartwick (1977, 1978) have developed an investment rule, known as the Solow-Hartwick rule, that operationalises the concept of weak sustainability. According to this investment rule, a society should invest all the current returns from the utilization of exhaustible resources, which under a number of rather restrictive assumptions guarantees that the loss of exhaustible resources is compensated by produced capital, so that the aggregate capital stock is held constant.

The concept of “strong sustainability” differentiates between natural and produced capital and defines an economy as sustainable if both the stock of natural and that of produced capital are non-declining. This view differs from the definition of weak sustainability in that natural capital is taken to be largely non-substitutable with produced capital, so that both kinds of capital have to be maintained separately<sup>32</sup>. The argument is that natural capital performs essential functions that other kinds of capital cannot provide.

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<sup>28</sup> Pezzey (1997, p. 451).

<sup>29</sup> See also Heal (1996) for a review of this approach.

<sup>30</sup> For a classification of different kinds of capital and a discussion of its importance for sustainability see Holland (1999).

<sup>31</sup> This idea has, e.g., been formalized by Pearce and Atkinson (1993). See Gutès (1996) for a discussion of the assumptions implicit in this aggregation.

<sup>32</sup> There also exist a number of concepts that claim that preserving the essential functions additionally requires a disaggregated notion of natural capital, see, e.g., Perrings (1995), Miller (1999).

In this line is also the notion of the “safe minimum standard” as introduced by Ciracy-Wantrup (1952). This definition implies that ecosystems have critical limits beyond which they collapse, so that sustainable policies imply keeping within these limits<sup>33</sup>.

Another approach to sustainability is that of providing basic needs. This is much in the spirit of the Brundtland definition and requires leaving enough resources for future generations to ensure that their basic needs can be met.

An approach to sustainability that is largely resource based but also includes welfare based elements is the concept of assessing sustainability by using fuzzy logic, as it has been proposed by Phillis and Andriantiatsaholiniaina (2001). In this approach, sustainability is not defined as a single criterion, but the sustainability of an economy is assessed by combining different variables through the use of fuzzy-logic. For the ecological system the variables air, water, land and biodiversity are assessed, and for the economic system the variables health, wealth, knowledge and policy variables. The use of fuzzy-logic allows to judge these variables approximately and to combine variables with different units, as well as resource based information and welfare based information. The model is adaptive, i.e., parameters can be added or deleted as the informational base changes, or as the judgment of relevant issues changes. As an output, the proposed model gives a degree of sustainability of the system under examination.

### **3.3.3 Sustainability and Theories of Distributive Justice**

Like their philosophical counterparts, the discussed economic concepts of sustainability can be divided into welfare based and resource based approaches. Strong parallels exist especially to the egalitarian theories of justice<sup>34</sup>. But while the philosophical theories advocate the equality of whatever is the object of justice, sustainability only requires that it is non-declining. The concept of sustainability thus defines justice only in one direction, namely from the present to the future<sup>35</sup>. Further analogies can be found concerning people’s respon-

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<sup>33</sup> However, from a perspective of justice this leaves open the question which ecosystems to preserve (keeping all ecosystems within their borders would make this criterion very restricting) and how to distribute assets like produced goods, so that this approach seems more suited as a part of sustainability than as a full-fledged concept itself.

<sup>34</sup> The parallels between justice and sustainability have been commented on by Barry (1999). An attempt to bring the discussions together is made in Dobson et al. (1999).

<sup>35</sup> The temporal aspect makes a concept based on reciprocity impossible, since although present persons may benefit or harm future persons, the opposite is not possible.

sibility. As in the theories of justice, the welfare based definitions compensate for preferences and situation whereas the resource based definitions do not. While the resource based approaches are thus philosophically not appealing since they hold people responsible for things outside their control, the welfare based approaches cannot deal with the uncertainty of the future, since they require the knowledge of future preferences.

The questions of responsibility and uncertainty were found to be central to intergenerational justice. However, the presented definitions of sustainability largely neglected these aspects. Thereby several important points concerning the choice between resource and welfare based concepts and concerning the procedure by which sustainability is judged (outcome based versus procedural approaches) remain unresolved.

### **3.3.4 Main Points: Definitions of Sustainability**

- There exist a multitude of definitions of sustainability.
- Definitions can be grouped into welfare and resource based definitions.
- Most welfare based definitions define sustainability as non-declining welfare. Their main problem is that future preferences are uncertain.
- Most resource based definitions define sustainability as non-declining resources. Their main problem is that the present dictates the relevant resources and that they hold future people responsible for things outside their control.
- There exist strong parallels between sustainability and intragenerational justice, but the main problems of intergenerational justice are not considered in the economic definitions of sustainability.

## **4 Economic Measurement of Intergenerational Justice**

In this section we explore two economic methods for the measurement of intergenerational justice. Specifically we explain the tool of generational accounting and overlapping generation (OLG) models. Both methods are widely used to analyse the distributional effects of long term fiscal policies such as social security, eco-taxes etc. In addition to describing the methods and some of their results (mainly for Europe), we also briefly discuss the limitations and possible extensions of these tools.

### **4.1 Generational Accounting<sup>36</sup>**

#### **4.1.1 Introduction**

The government's fiscal policy affects not only the present generation but also future generations: someone must pay at some time for all that the government spends. An answer to the question "just how sustainable (or equitable) are the government's financial policies?" is not readily available - especially when the answer to this question should contain information not only for the present generations but also for future generations.

Government budgets (and specifically budget deficits) are conventionally used as indicators of fiscal activity. The budget is based on annual government spending and revenue and shows the short time or mid-term effects of fiscal policy on demand. An estimate of the short and middle term budget deficit, when used as an indicator either for the results of fiscal policy or the state of the future economy, has limited use. The deficit only records the increase in government debt held by the public, i.e. obligations that people purchase with cash and present for payment at a later date. This cash pays for public spending in excess of government revenue. The use of the deficit as an indicator has several known major shortfalls. Fiscal policy is dynamic and should not be described by a short time measure that ignores the likely course of future policy. Furthermore, measuring the deficit does not help identify who actually pays for the overspending and when it must be paid.

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<sup>36</sup> This subsection relies heavily on the following authors and publications: The theory of Generational Accounting as described by Auerbach, Gokhale and Kotlikoff; information from the US Congressional Budget Office; studies carried out by DG Economic and Financial Affairs of the European Commission; and various other authors.

It is assumed that rational citizens and other bodies consider their lifetime resources when making economic decisions and that they are only influenced to a small degree by present government budget figures. This means that a long term assessment or an approach more similar to a life-cycle analysis could be used to estimate how the government's fiscal policy today affects the decision making process and the resources of present (and future) generations. This approach should also include information about the fairness or equity of fiscal policy, firstly between those living now (by age or other criteria) and secondly between the present and future generations.

Alan Auerbach, Jagadeesh Gokhale and Laurence Kotlikoff have developed a model called Generational Accounting to determine the effects of policy by age groups (and by gender) for the present and future generations, thus intending to improve on the quality of data obtained by budget deficit accounts. Generational accounts aim to record all obligations that a policy undertakes and to estimate how it directly transfers resources amongst people of all ages, including future generations.

Generational accounts provide information about who pays and when they pay for all that the government buys. The government uses cash to pay for payments to individuals, for the construction of transport infrastructure, for providing education, national security through the military and so forth. Citizens of different ages pay for these purchases with their net taxes. *Net taxes* are defined as the total of taxes paid over a lifetime less transfers in the form of government payments (for example social security, welfare). This means, that the accounts show the real (i.e. inflation adjusted) amount that each average member of a generation (calculated by age group) pays to the government during their lifetime. The accounts can also be applied to the past or future generations. They can aim to show the effects that the present fiscal policy will have on the net tax burden of the average member of representative future generations.

#### **4.1.2 Basic Methodological Assumptions**

The methodology of generational accounting uses two basic assumptions: firstly, the present value is used for all payments and secondly, there is a zero-sum constraint for government spending.

- The accounts are calculated using the present value for all prospective net taxes. Present value expresses the stream of net payments over time by what they would be worth if they were all paid at a given date as one sum. This puts the prospective net taxes of each person, no matter what generation or age group they belong to, on the same basis. This can be viewed in a similar manner to a willingness to pay approach: the net amount that a person is willing to pay at one time, then never again pay taxes or receive transfers. To calculate this present value a discount rate is used.
- The accounts require an intertemporal budget constraint for the whole public sector. This means that all present and future government expenditures (including transfers such as social security) must be covered by either government net wealth or by present and future net taxes. In other words, future generations must pay with interest for all purchases that past and present generations did not pay for. If this constraint is not held, this means that the government will default on its creditors. This does not mean that the accounts calculate the cost of paying off all national debt, the accounts consider only the servicing of national debt.

### 4.1.3 The Accounts Equation

Relying on the two basic constraints given above, the accounts are calculated based on a simple equation as set out in Auerbach et al. in 1994:

“the present value of the remaining net tax payments of the present generation plus the present value of net taxes of future generations must equal the present value of all government consumption minus the government net wealth”.

This statement is meant to be seen as an equation in mathematical terms. If the present consumption of the government is held constant and a reduction in the present value of taxes paid by the present generation is granted then this necessitates an increase in the present value of net tax paid by future generations.

The model can be expressed in an algebraic form:

$$\sum_{s=0}^D N_{t,t-s} + \sum_{s=1}^{\infty} N_{t,t+s} = \sum_{s=t}^{\infty} G_s (1+r)^{t-s} - W_t^g$$

The term  $N_{t,k}$  stands for the account of the generation born in year  $k$ . The index  $s$  in the first summation runs from age 0 to age  $D$ , the maximum length of life. Hence, the first element of

this summation is  $N_{t,t}$  which is the present value of net payments of the generation born in year  $t$ ; the last term is  $N_{t,t-D}$ , the present value of remaining net payments of the oldest generation alive in year  $t$ , namely those born in year  $t-D$ . The second summation starts with the term  $N_{t,t+1}$ , the present value in year  $t$  of the payments of the generation born in year  $t+1$ . The values of government consumption in year  $s$ , given by  $G_s$ , are discounted by the pre-tax real interest rate,  $r$ . The remaining term on the right hand side,  $W_t^g$ , denotes the government's net wealth in year  $t$ .

This zero-sum equation allows the following question to be answered: if fiscal policy remains as it is for the current generation for the rest of their lives, how much would they have to pay in net taxes and how much would future generations have to pay. When looking at the equation it becomes obvious that the generational account is not designed to guide or to predict the course of government policy but rather to model the consequences of present or presently proposed policy on the tax burden of present and future generations.

Keeping fiscal policy constant, the accounts project government purchases and net taxes of current generations and calculate their present values. Given the level of government debt in the base year, the accounts then calculate the present value of net taxes of future generations through the zero-sum constraint. This procedure depends on economic and demographic projections, assumes a discount rate, and requires a policy rule that determines taxes and spending for current generations according to age. The results obtained from the accounting exercise are a set of values, one for each existing and future generation. The same accounting principle can be used to extend the account to include male and female cohorts within each generation.

Since generational accounts reflect only net taxes paid to the government, they do not attribute the value of all government purchases of goods and services provided back to the generations. The value that these services bring to an individual, such as motorways, national security and other services do not directly show up within the account. Therefore the accounts do not show the full net benefit or burden that any generation or individual receives from government policy. However, they can show the change in a generation's net benefit or burden resulting from a particular policy change that affects taxes or transfers.

#### 4.1.4 Construction of a Generational Account

A generational account is constructed following a set of basic principles. Using projections of current taxation and transfer plans the current net tax payments of the present generation are calculated for the rest of their estimated life spans. The accounts must breakdown net taxes and revenues into broad components because each particular tax or transfer varies with the age of the payer or recipient. The allocation of taxes and transfers to age groups is rather arbitrary and necessitates the combination of macro-statistics on the government's revenues and expenses with micro-statistics on household income and expenditure. From this data, age profiles are developed showing the net tax payment or transfer of a representative individual in the base year. These age profiles can also be computed to show gender or other factors. Because the account for the present generation requires information for the life span of each individual, a projection of the net taxes and transfers is needed for the years in the future up until the time when a person born in the base accounting year no longer pays taxes or receives transfers.

The next step in the calculation of generational accounts is to assume that the age and gender profiles of presently living generations will not change. For example, a 20 year old woman will, in 15 years, pay an annual amount of net taxes which equals the net amount of taxes paid by a 35 year old woman today (taking productivity growth over the 15 years into account). This assumption implies that the fiscal policy current in the base year remains constant for the indefinite future. The only exceptions to this rule are those policy changes which were decided on in or before the base year. The effects of these policy measures on the development of age specific payments are taken into account. Combining the projected age profiles with the projected population structure allows the calculation of the rest-of-life net tax burden of living generations.

In order to complete the governmental side of the generational equation, data regarding governmental wealth (tangible assets) is required. Tangible government assets provide services that people consume during their lifetime, for example transport infrastructure. These assets are treated as purchases for the basic accounts rather than estimating the value of the consumption of these assets. The next major step needed for the completion of the account is the calculation of the present value of future government consumption. This assessment is based on short and mid-term government budget plans (as available) and must extended beyond this time frame for the extent of the account. The allocation of federal, state and local governmen-

tal expenditure is divided amongst age groups as far as possible, but no conclusive methodology has yet been presented. For example, some accounts ascribe education costs to the younger generations (receiving end), other accounts allocate this expenditure to the parent's age group (would pay if education was not a public service) other accounts have allocated these costs on a per capita basis. Expenditure for public goods such as defence, transport infrastructure or public safety is sometimes allocated on a per capita basis (as in TAXUD 2000) or not allocated as a transfer at all. Generally, public goods in place before the base year of the account are not retrospectively allocated to age groups, they are excluded from the account.

Once the account for the present generation is completed, it is now possible, using the assumed government's intertemporal budget constraint, to extend the account to future generations. Because the focus of the account is not the aggregate taxes paid by all generations but the calculation of the net taxes paid by a representative of each future generation, the account then calculates net taxes of a representative individual for the generation "base year minus one". In order to do this it must be assumed that all future generations face the same set of accounts if these accounts are discounted to the time of their birth and adjusted for productivity growth. A generational imbalance is seen to exist if the accounts show a difference in net taxes for the base year new-born and the growth-adjusted account of a future new-born.

From this simplified description of the accounts methodology it can be clearly seen that the calculation of the accounts requires extensive and detailed basic data from different sources. Additionally, expertise in the making of assumptions that have a major effect on the results such as the discount rate, the growth rate, government expenditure over time, the size of the present deficit and the overall demographic development are clearly required. For example, within the generational accounts carried out by the European Commission in 1996 (TAXUD 2000) a standard discount rate of 5% and a real growth rate of 1.5% was used for all countries participating in the accounts exercise. For the accounts presented in Auerbach et al. (1994) and CBO (1995), both for the USA, a discount rate of 6% was assumed. CBO uses a growth rate of 0.75%. Government spending is usually kept at the same ratio to GDP as in the base year. The determination of the present budget deficit is one of the most difficult estimations within the account. Auerbach (1994), CBO (1995) and Kotlikoff and Raffelhüschen (1995) describe the difficulties in estimating the "correct" level of the deficit. Demographic forecasts are normally taken from governmental statistical offices. In many countries population ageing

is a major factor that affects the results of the accounts, therefore, the accuracy of demographic projections is crucial.

#### **4.1.5 Results of Present Generational Accounts**

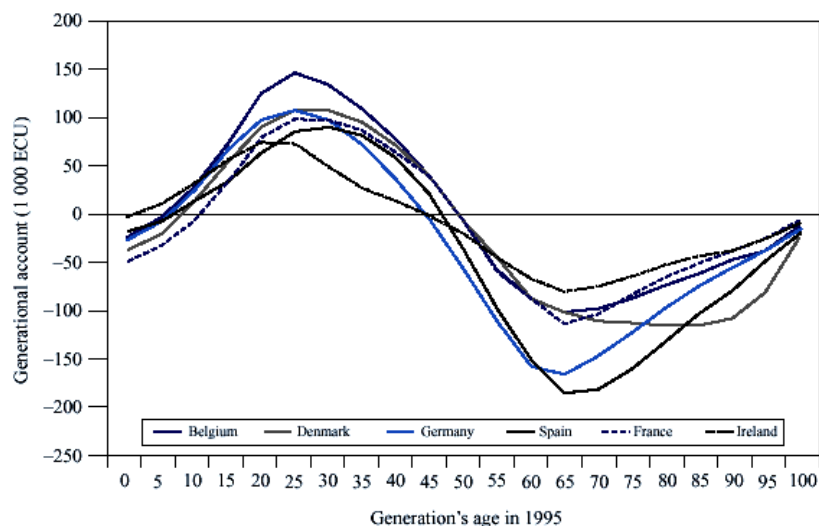
Within our literature research concerning generational accounting we have found completed generational accounts for 23 countries. There seem to be three different approaches to using the accounts results: firstly, analysing the account for the present generation (and comparing new-borns in the base year with new-borns in the base year minus one), secondly, creating a retrospective account and thirdly, constructing the account and carrying out “what if” exercises to estimate the results of fiscal policy or demographic change with the aim of producing a stable lifetime net tax burden between members of differing generations.

##### **4.1.5.1 Accounts for the present generations**

The generational accounts calculated by the European Commission (TAXUD 2000) show the rest of life net tax payments by age for the present population (in a further publication (Raffelhüschen 1999) these results are examined and the impact of present fiscal policy on future generations is discussed). In the countries studied (Belgium, Denmark, Germany, France, Ireland, Italy, Netherlands, Austria, Finland, Sweden, UK) follow a typical pattern over the population age. For the new-born individual, the accounts were roughly balanced, meaning that the lifetime net tax payments roughly equalled the net transfer receipts. The present value of imminent schooling and higher education expenditure by the state (which was attributed to the younger generation in the European studies) combined with the strongly discounted old-age benefits more or less balance the account for this age cohort. As the youngest generation becomes older, its members benefit less and less from education expenditure. Around the ages between 25 and 35 the generational accounts reach a peak since a large part of these age groups do not benefit further from education expenditure but have moved into the workforce. At this stage, the burden of taxes linked to employment or business activities, that remain to be paid over the rest of the lifetime, do not outweigh the expected discounted old-age transfers. At approximately between the ages 45 and 55 tax and contribution payments which the individual faces over his or her remaining lifetime are offset by old-age pensions, health care and similar transfers from the state. Around the age of retirement (60 to 65) taxes are significantly reduced. At this stage of the lifecycle age old-age pensions are granted and the generational accounts exhibit the highest negative values. With increasing age, the generational ac-

counts approach zero again due to the declining life-expectancy. Figure 1 (taken from TAXUD 2000) shows the typical generational net tax payment curve for the countries Belgium, Denmark, Germany, Spain, France and Ireland. When looking at figure 1, it should be remembered that the country graphs show the rest of life net tax payments per age group, not the whole life net tax (except, of course, for the new-born generation).

**Figure 1: A Comparison of Generational Accounts within the EU**



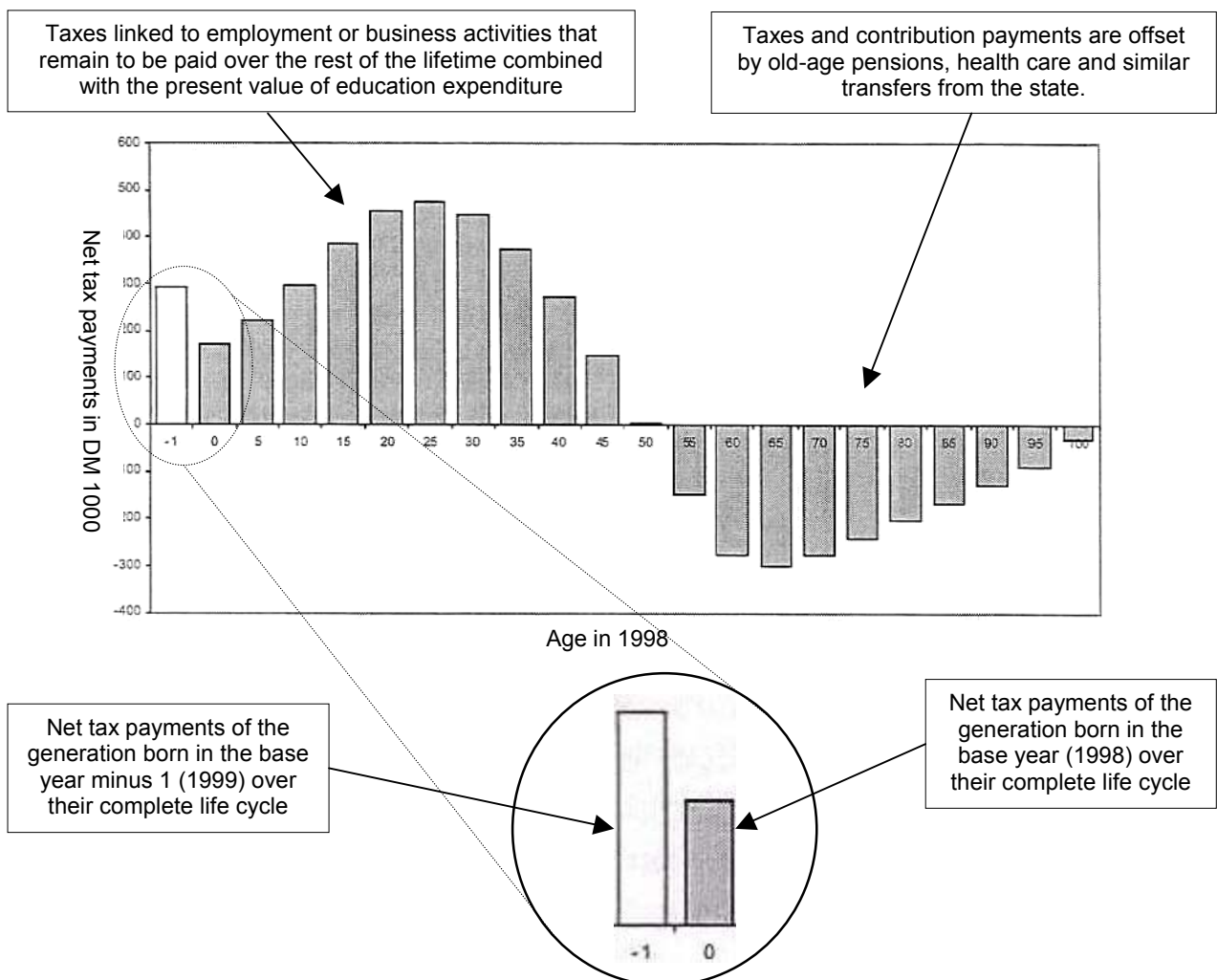
Source: TAXUD 2000

The major use of these kind of studies is to identify and gauge the effects of changes to fiscal policy on each age group in the present generation. However, due to the forward looking nature of the accounts, the net tax burden of different age groups can not really be compared. The account of older people looks more favourable when compared to the accounts of middle aged or young people. This is explained by the fact that older people on average pay less taxes and receive more transfers than younger people. The generation born in the base year is the only generation showing net taxes and transfers over their complete lifecycle.

An example of an account being constructed to compare the net tax paid by the present new-born generation with those of a future generation is given in Feist and Raffelhüschen (2000). This study shows an account for Germany using 1998 as the base year and using a discount rate of 3% and a 1% growth rate. The pattern of the account for present generations follows the general pattern described above and shown in figure 2. In the account a comparison of base year (1998) new-borns with new-borns born in the year after the base year (1999) is given. These two cohorts allow a comparison of net taxes over the complete lifecycle for each

group. For those born in 1999, it is assumed that they will pay similar net taxes to those in the base year of 1998 (adjusted according to the growth rate etc.). In keeping with the intertemporal budget constraint, budget deficit accumulated in previous generations must be added to the government spending side of the accounts equation resulting in an increased net tax rate. Within this study, a 69% increase in the net tax rate between those born in 1998 and 1999 was identified as being necessary to balance out the deficit from previous years. Here, the emphasis of the results is to assess the economic equity between new-borns of two different years, see figure 2.

**Figure 2: Generational Account for Germany 1998**



Source: Feist and Raffelhüschen 2000 (modified)

### 4.1.5.2 Retrospective accounts

An example of the second major approach to generational accounts, a retrospective generational account, is given in CBO (1995). In this study the net tax burden of previous generations in the USA is compared with the net tax of present generations. This type of study has the advantage of being able to use robust available data (fiscal policy, government revenues, demographic data) rather than relying on data estimations, the assumption of constant fiscal policy and budget constraint. Table 2 shows the results of the CBO retrospective account.

**Table 3: Estimated Lifetime Tax and Transfer Rates by Year of Birth**

Year of birth	Net tax rate <sup>^)</sup>	Gross tax rate	Transfer rate
1900	24	28	3
1910	28	33	6
1920	29	36	7
1930	31	39	8
1940	32	41	9
1950	34	44	10
1960	35	46	11
1970	36	50	12
1980	37	51	13
1990	37	51	13

<sup>^)</sup> A lifetime net tax rate is the present value at birth of lifetime net taxes as a percentage of the present value at birth of lifetime labour income. The net tax rate equals the gross tax rate less the transfer rate (differences due to rounding).

Source: CBO (1995)

The results of this study could be used as an indicator for intergenerational equity between past and present generations. It should, however, be kept in mind, that rising lifetime net tax rates did not necessarily make successive generations worse off than their predecessors.

### 4.1.5.3 Comparison the present and future generations

The third method of using information from generational accounts is to estimate the results of fiscal policy or demographic change and then show the tax burden necessary to produce a balanced account. Kotlikoff and Raffelhüschen (1999) have compiled information on generational accounts from 22 countries and use these accounts to discuss the possible fiscal measures a government can use to create a financial balance between generations. To obtain this balance four fiscal policies are considered: cutting government purchases, reducing government transfer payments, increasing all taxes and increasing income taxes (personal and corporate taxes). The magnitude of the adjustments needed to balance the account can then be seen

as the imbalance between generations. Education is considered to be a government transfer for the discussion of results.

If a reduction in government spending (at the national, state and the local level) is the only way that the intergenerational imbalance is to be countered, then 13 of the 22 countries (Japan, US, Argentina, Brazil, Austria, Denmark, Finland, Spain, Sweden, Netherlands, Germany, France and Italy) need to reduce their non-educational spending by over one fifth. In Ireland, New Zealand and Thailand future generations benefit from the tax burden that present generations pay and they face lower net taxes than current levels. This means that theoretically these four governments can spend more over time without unduly burdening generations yet to come. Canada, UK, Portugal, Norway and Australia show moderate generational imbalances when this is measured using necessary government spending cuts (approximately 10% or less). The second alternative, cutting transfer payments from the government shows similar results. Japan shows the most drastic cuts (25.3%) necessary to create a balance between the generations. In the US the figure is 20%, in Germany 14%, in Italy 13%. Ireland, New Zealand and Thailand again show negative transfer payment levels showing that intergenerational financial equity is possible- even with an increase in governmental transfer payments. If the generational accounts were to be balanced through an increase in all taxes, Finland would have to increase current taxes by over 19.4%, Austria by 18.4%, Japan by 15.5%, the US by 10.8% and Germany by 9.5%. An increase in income taxes only in order to balance the generational account would theoretically cause a 75.7% increase in Argentina and a 74% increase in Brazil. The US would experience a 9.5% increase and Germany a 29.5% increase. In contrast, Ireland could cut income tax by approximately 5% and not burden future generations. This comprehensive report shows severe intergenerational imbalances that will require great changes to fiscal policy if intergenerational equity on the basis of net tax burden is desired.

Generational accounts have been adapted to shed light on specific problems facing individual countries. For example the problem of an ageing population in several countries is the subject of Raffelhüschen and Risa (1997) and specifically to Japan in Takayama and Kitamura (1999). In their paper Fisher and Woo (1997) tackle the problem of including expected foreign monetary transfers within an account for Korea. Intragenerational and intergenerational economic sustainability are discussed in BMF (2001).

#### **4.1.6 Limitations and Criticism of Generational Accounting**

Since generational accounting was developed in the 1980's a whole spectrum of praise and criticism for the model has been expressed. The accounts must be applauded as an attempt to show the balance between government spending and taxation imposed on the citizen over the present and future generations. Many countries have constructed an account and the information gathered from the calculations have started a wide debate about the sustainability of government fiscal policy.

However, generational accounts are not perfect, the methodology has limitations. One of our major points of criticism, when viewing the accounts in terms of sustainability or equity between generations, is that they do not describe the overall well-being of generations, they only compare the economic burden placed on a representative member of each generation considered. A balanced account does not necessarily mean that there is equality between generations, an account showing imbalances does not inevitably mean that one generation is better off than another. In much of the literature describing generational accounts for specific countries, the net tax burden has been used as a simile for the overall health and welfare of generations. This is clearly not correct. The accounts only show the net tax burden arising from government spending for the generations studied.

##### **4.1.6.1 Theoretical objections to the accounting methodology**

There are two major theoretical objections to the methodology presented by Auerbach et al. (1994) for creating a generational account. The first questions the validity of the underlying lifecycle approach. The second criticises the incidence assumptions.

Many authors query the lifecycle approach used within the generational accounts to describe the underlying consumption pattern of life time resources for individuals within a generation (see for example CBO 1995, Haveman 1994 or TAXUD 2000). Within the accounts, the planning horizon of individuals does not differ from or reach beyond their lifecycles. This assumption may not be correct. It is further criticised that consumption patterns are assumed to be static, no reaction to the fiscal policy (or indeed to the results of the comparison between generations) is taken into account. A planning horizon that reaches out over one generation's lifetime, or is much shorter than a life cycle, changes the results gained within the accounts with regard to a utility based interpretation. This is the case, for example, if bequests are given from one generation to another. These bequests may offset intergenerational redistribu-

tion induced by government tax and transfer policy. In the extreme altruistic case, redistribution through government budgets would be counterbalanced by private intergenerational transfers. If this is true, there would be no need for generational accounting, government policy would not lead to generational redistribution. In the other extreme, if members of a generation have a much shorter planning horizon than their lifecycles (for liquidity constraints or myopia) they would base their consumption decisions on their current income. If this is the case, the timing of income, tax payments and transfer receipts affects individual well-being. Related to the lifecycle approach, the correctness of the budget constraint requirement within the accounts is questioned. In Auerbach et al. (1999) no member of a present generation is affected by this requirement, their net taxes and receipts are calculated as if the government operated without constraint. As a result, the burden of obtaining a balanced budget is shifted to future generations. This is why the new-born generation (minus one year) faces a much higher net tax burden than those of the base generation born one year earlier.

The second theoretical objection against generational accounting concerns the incidence assumptions employed. The method neglects to estimate the impacts of net tax burden on the quantities and prices of consumption and investment, and the repercussions on factor inputs in the production process (TAXUD 2000). Since pre-tax factor returns are taken as constant, the incidence of all tax payments and transfer receipts falls directly on the respective taxpayers or transfer recipients. This implies for example, that workers bear the entire labour income tax burden and that the labour income tax burden of each agent equals the tax amount paid. This is, of course, not necessarily true. The relevance of macroeconomic repercussions need to be clarified for the validity of generational accounts. To accurately assess tax or transfer incidence, a fully specified dynamic equilibrium model is necessary. This has been shown by Raffelhüschen and Risa (1997) for the case of social security payments in an ageing society. An example of an account using a dynamic feedback model showing the results of macroeconomic change, is given in Fehr and Kotlikoff (1996).

#### **4.1.6.2 Questioning the empirical assumptions needed for the accounts**

Many empirical limitations have been identified within the methodology of generational accounting. These kinds of limitations are not specific to the generational accounts, many other areas of research base their finding on estimates of empirical data.

The results of generational accounts rely heavily on calculations based on demographic and economic projections. All empirical assumptions are to some extent arbitrary, and equally defensible assumptions would yield an equally reasonable but probably very different account (Haveman 1994). Detailed population projections by age and gender (which extend to more than 200 years into the future) are necessary for the completion of the accounts. Most official projections typically cover a time period of 30 to 50 years. Projections for the remaining years (which include the fertility rate, mortality, migration etc.) must be made by those completing the account. The estimation of age specific taxes and transfers requires assumptions regarding the economic incidence of taxes and transfers. The allocation (or non-allocation) of government expenditure to the age groups of the individual accounts is also purely arbitrary and differs greatly between the accounts reviewed for this paper. This allocation problem is worsened by the difficulty in the assessment of benefits from government spending. The costs of medicine, education or pollution control can be estimated fairly accurately but the benefits (or allocation of the benefits to specific age groups) of these expenditures to the present and future generations is often ignored.

The estimation of government net wealth (on all governmental levels) is necessitated by the intertemporal government budget constraint required by the accounting equation. This includes the government debt on all federal levels and also the accumulated debt of public enterprises. Government liabilities (in economic rather than legal terms) must also be considered where they occur. The estimation of government net wealth is determined through balancing gross debt with the value of governmental asset holdings. The estimation of tangible governmental assets is not always straightforward. The sale or lease of a government asset may not always reflect the real social value of this asset. For example the government may receive fees that are lower than the market value for mining rights or timber from public land. The social value of landmarks or public monuments for example are difficult or impossible to estimate. Additionally, the accounts do not show unexpected changes in the value of government assets. A good example of this would be the discovery of oil on public land.

One of the most discussed parts of the accounts methodology is the discounting procedure used. Choosing a discount rate is always a difficult and somewhat arbitrary decision. There are two major considerations when determining the discount rate for a generational account. Firstly, the conventional discount rate expressed as the cost of waiting and secondly the cost of risk inherent in the prospective streams of net taxes. Within the accounts it is assumed that

capital markets are efficient, implicitly meaning that everyone can borrow or lend any amount of money at the given rate of discount. This is obviously a great simplification for the basis generation and a major potential source of error for future generations. The discount rate as used within the generational accounts must also take into account the risk of future lower government net revenues. In this case future generations must pay more taxes to balance the accounts equation. A single discount rate is used for risk and waiting for all generations of the account. Apart from possible inaccuracies in the discount rate determination, the possibility that a discount rate may be different for different age groups, or that a discount rate may differ over time are not considered within the overall methodology. However, the usefulness of a discount rate is never questioned, the discussion revolves around the actual percentage used, if the rate should be kept constant or the necessity of sensitivity analysis using different rates.

#### **4.1.6.3 General criticism of generational accounting**

Generational accounting as described by Auerbach et al. (1994) is a static model. The profiles created for the base generation are assumed to be constant for all future generations. The fiscal policy written down for the present generation stays constant over the whole time horizon of the account. No macroeconomic feedback in reaction to fiscal policy is calculated. This is, of course, a major simplification. If the effects of fiscal policy are incorrectly estimated for the base generation, this mistake can lead to extremely false results for the future generations.

When using generational accounts to compare the lifetime net tax level of present and future generations, the basis year chosen plays a major role in the outcome of the results. If the base year is economically “good” then the next generation will show either a similar or better lifetime net tax to the new-born generation in the base year. If the year chosen is a “bad” year from the economic point of view, the difference between the two new-born generations will be large. This methodological anachronism leaves the accounts open for manipulation, the results gained are entirely dependent on the economic performance in the base year.

#### **4.1.7 Conclusion**

Generational accounting is one instrument which can be utilised to identify the long term implications of current fiscal and social policy. We have identified 23 countries that have constructed generational accounts. Taking into account the future demographic development, generational accounting shows which effects the continuation of a given policy will have on the net tax and transfer payments of the present and future generations. Specifically, genera-

tional accounts can show if fiscal policy is sustainable between generations or if future generations will have to pay for the present government's expenditure.

## 4.2 Overlapping Generations Models of Fiscal Policy<sup>37</sup>

### 4.2.1 Introduction

Sustainable development requires that future generations be able to satisfy their needs as current generations do. Conceptually, it encompasses social, ecological and economic aspects. In order to link these aspects, the instrument of an ecological tax reform has been developed since 1980. Such a reform implies that taxation of socially benign activities can be reduced and substituted for by taxation of ecologically negative activities ("double dividend"). Assessing the long-term effects of such a tax reform requires considering the structure of a given population. This can be done by means of intertemporal economic models such as the Ramsey model and Overlapping Generations (OLG) models. In the following section, two ecologically oriented OLG models will be described with regard to their basic structure and findings from their application.

The first model that explicitly covers a compensation between the present and the future was developed in the 1920s by Frank Ramsey. What we call the sustainability problem today has partly been integrated into the Ramsey model as a choice between consumption and saving. The model assumes a closed economy and representative households which live infinitely. Also, the model households abstract from the real age structure of populations.

As opposed to this, an age structure is considered in OLG models, in which several individuals of different generations live at a given point in time. Every individual is assumed to follow a life cycle from birth to death with its income depending on age: at the beginning, income increases; it decreases when approaching the pension age and finally equals zero in the last period of the life. This life cycle is explained by the dependence of productivity on age. Consequently, savings are high in young years and get smaller and smaller the older an individual gets. This assumed life cycle allows us to analyse the influence of the age structure on total savings and to assess the economic problems of aging.

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<sup>37</sup> This section draws from Schwarze and Welsch (2001).

Results from policy analysis based on OLG models depend on the incorporation of three specific features. First, the individuals in the model can be assumed to be either egoistic or altruistic. In contrast to the former, the latter want their descendants to benefit from them. Second, OLG models can contain cohorts with constant or with changing sizes over time. Changing cohort sizes allow to represent an increasing share of pensioner households. Third, OLG models differ as to how they model the labour market. This is especially important with regard to the effects of ecologically oriented policies on employment. Generally, some models assume perfect competition on the labour market, whereas others assume imperfect competition with involuntary unemployment. Furthermore, labour supply can be modelled micro-economically as an explicit labour-leisure decision or can be given exogenously. Fourth, besides other forms of taxes, OLG models can contain ecological taxes with varying redistribution schemes .

OLG models have been applied to study the consequences of an ecological tax reform, i.e. taxes on CO<sub>2</sub>, two of which will be presented here.

#### **4.2.2 Results**

Pahlke (1998) models Germany as a small closed economy with 10 production sectors differentiated according to their energy and CO<sub>2</sub> intensity over 14 periods. Each period is 10 years long. The redistribution of CO<sub>2</sub> taxes is revenue-neutral, individuals are assumed to behave egoistically, labour supply is modelled explicitly, and there is no involuntary unemployment. The effects of economic policies are compared to an equilibrium growth path starting in 1993 which does not consider structural change. The analysis shows that there is a “double dividend”, i.e. welfare benefits, from an ecological tax reform in the short run, but - independent from tax redistribution – welfare losses in the long run such as decreasing GDP, employment and investment. Reduced investment, in turn, leads to a redistribution between generations so that older generations gain whereas younger generations lose. This is further increased by the assumed egoistic behaviour of the individuals.

Wendner (2001) models Austria with seven distinct production sectors according to their CO<sub>2</sub> emissions. He also incorporates the dynamics of an aging society with differing cohort sizes and decreasing birth rates. Differing from Pahlke, Wendner assumes altruistic individuals and exogenous labour supply. His model serves to analyse the effects of a CO<sub>2</sub> tax that assures reaching the Kyoto targets. The redistribution of tax gains is modelled either as transfers to

households, as a reduction in labour costs or a decrease in social security contributions. The first redistribution policy leads to decreasing wages, and the second to a reduced real lifelong income of some cohorts implying lower consumption and investments. The third policy option avoids those negative effects by using 60% of the tax gains to reduce social security contributions and 40% to reduce labour costs. The outcome of this option also includes positive effects on lifelong income, consumption, savings and investments compared to the reference path without an ecological tax reform.

### **4.2.3 Conclusion**

The two compared OLG models are helpful instruments to analyse long term-oriented strategies for sustainable development. They have not sought, however, to interpret sustainability in the broadest sense but only with regard to greenhouse gas reduction which is a central environmental issue for industrialised countries. Incorporating dynamic age structures into OLG models is an essential prerequisite for representing an aging society. Independent from their other features, the models can shed light on the intergenerational distribution of capital ownership whose long term consequences, however, depend on the assumption of egoistic or altruistic individuals respectively. Both models assume perfect competition on the labour market which is very unrealistic for European economies. Such an assumption does not allow the analysis of unemployment in different cohorts which - because of their different productivity. - are affected differently. Future OLG models should therefore reflect the issue of unemployment in order to improve the description of intergenerational effects resulting from an ecological tax reform. They should also go beyond using greenhouse gases as the only indicator of ecological sustainability.

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## 6 Experts Questions

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

Sustainability
<ul style="list-style-type: none"><li>• Can equity between generations be used to indicate economic sustainability?</li></ul>
<ul style="list-style-type: none"><li>• What is the appropriate <i>subject</i> of intergenerational justice: the individual, or generations, or ...?</li></ul>
<ul style="list-style-type: none"><li>• What is the appropriate <i>object</i> of intergenerational justice: welfare, or resources, and which resources?</li></ul>
<ul style="list-style-type: none"><li>• What are the underlying assumptions about substitution processes, production possibilities, and ecological processes?</li></ul>
Responsibility
<ul style="list-style-type: none"><li>• Which obligations to future persons exist, and how far do they reach?</li></ul>
<ul style="list-style-type: none"><li>• For which preferences and which aspects of their situation should people be held responsible?</li></ul>
Behavioural Models
<ul style="list-style-type: none"><li>• Do we need economic models of endogenous preferences to tackle the problem of intergenerational equity?</li></ul>
Uncertainty
<ul style="list-style-type: none"><li>• How to deal with the uncertainty of future <i>values and preferences</i>?</li></ul>
<ul style="list-style-type: none"><li>• How to deal with the uncertainty of the future <i>situation</i>?</li></ul>
Separability
<ul style="list-style-type: none"><li>• Can intra- and intergenerational justice be treated separately?</li></ul>

## Session II: Intergenerational Justice and Fiscal Policy

<b>Generational Accounting</b>
• Can the lifetime net tax rate be used as an indicator for equity between generations?
• If so, can equity between generations be used to indicate economic sustainability?
• If so, can the accounting procedure be adapted to gauge sustainability in other areas, e.g. environmental sustainability?
<b>Overlapping Generation Models of Fiscal Policy</b>
• Can OLG models be used to assess the effect of fiscal policies on equity between generations?
• If so, can equity between generations be used to indicate economic sustainability?
• If so, can OLG models cover other aspects of sustainability?
<b>Other methods of measuring intergenerational justice</b>
• Are there other methods for an economic measurement of intergenerational justice?