Journal of Environmental Economics and Management 71 (2015) 34–53

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

On sustainability and social welfare ☆

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ARTICLE INFO

Article history:
Received 7 August 2013
Available online 27 February 2015

JEL classification:
D6
D9
O2
Q5

Keywords:
Sustainability
Genuine savings
Ecological footprint
Social welfare
Overlapping generations

ABSTRACT

This paper proposes to define sustainability in terms of leaving it *possible* for future generations to sustain certain defined targets. It is shown that variants of genuine savings and the ecological footprint can then serve as indicators of sustainability. The link between sustainability and intergenerational welfare is examined, and it is shown how to incorporate indicators of sustainability into a social welfare measure, including risk in the analysis.

> "It is very hard to be against sustainability.
>
> In fact, the less you know about it, the better it sounds."
>
> Robert Solow (1991, p. 179)

Introduction

Ever since the Brundtland Commission characterized sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission, 1987), sustainability has become a convenient slogan in the difficult exercise of pursuing the conflicting goals of bringing affluence to all human beings while preserving the capacity of the Earth to bear the human population.

It is exciting for economists to analyze such a notion and see if we can make sense of it in our theory. In this paper, I argue that, among the definitions adopted in economics, one conception of sustainability better captures the idea of sustainability than others, namely, the notion of giving future generations the *ability* (a word used in the Brundtland formulation) to sustain certain targets (Section "Definitions of sustainability in the literature"). But, although the literature has examined how to incorporate a priority for the future in intergenerational welfare objectives, it has not provided exact

☆ This paper, delivered as a keynote address at the EAERE Congress in Toulouse, 2013, has considerably benefited from advice and comments by G. Asheim and V. Martinet, though they should not be held responsible for any mistake. Comments by three referees and the editor are also gratefully acknowledged.

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http://dx.doi.org/10.1016/j.jeem.2015.02.005
0095-0696/

indicators of sustainability (as defined here) and has not tried to make sustainability indicators a component of social welfare—this is what this paper studies. (The relationship with the literature is not explained further in this introduction and is discussed in detail at the beginning of each main section.)

The purpose of this paper is therefore threefold. (1) The ultimate goal is to see if sustainability indicators can be incorporated into a measure of social welfare. (2) For this purpose, a simple indicator of sustainability is needed, and therefore the paper first examines how sustainability can be defined and measured. (3) Finally, another goal of the paper is to make the analysis amenable to possible future applications, which requires showing that the analysis can incorporate uncertainty and can be applied in the more realistic context of overlapping generations.

To give a flavor of the main results, the sustainability analysis of social welfare that is made possible by this analysis takes the following form:

- When the future path is known for sure: intergenerational welfare can be approximated by the level of welfare of the present generation diminished by an indicator of unsustainability (equal to the fraction by which what future generations can sustain falls behind the present generation's welfare), or augmented by an indicator of sustainability (which is similar but not equal to the proportion in which what future generations can sustain is greater than the present generation's welfare), and further modified by a term measuring the difference between the sustainability capacities of future generations and their actual predicted achievements;
- When there is uncertainty about the future feasibility set and the future path: expected intergenerational welfare can be written in similar fashion as above, but the (un)sustainability terms are the product of the probability of (un) sustainability by the (un)sustainability indicators computed on the basis of the expected welfare level that the future generations can sustain.

This analysis shows that it is helpful to cast the design of sustainability indicators in the context of social welfare, because this gives useful guidance for the selection of the most relevant indicators. In Section “Indicators of sustainability under perfect information” we will see that at least three indicators could be considered (two variants of the ecological footprint, and a variant of genuine savings). Moreover, the study of the uncertainty context shows that it is not just the probability of unsustainability that one should worry about, but also the expected extent of the sustainability deficit. And a convenient combination of the two considerations is made possible by their incorporation into intergenerational welfare analysis.

The choice of framework is important (Section “Model”). Finding simple indicators of sustainability is made much easier by adopting a discrete time framework, because discrete time makes it possible to obtain a clear distinction between what the current period does and what the next periods can do given the capital stocks they inherit. The literature on sustainability indicators has often focused on continuous time models, in which optimization techniques are well developed. But sustainability is a concept that refers to the transmission of capital to the next periods, and a key message of this paper is that it is worthwhile analyzing sustainability in discrete time models (with successive generations and also in models with overlapping generations). As most economic data are provided in discrete time (annual), it is also practically useful to develop measures adapted to such data.

Therefore, starting with a discrete-time successive-generations model, I obtain simple indicators of sustainability, including a variant of genuine savings and two variants of the ecological footprint (Section “Definition of sustainability and first indicator” and Section “Sustainability and risk”). The Appendix provides a detailed discussion of the classical notion of genuine savings and compares it to the variant proposed here. It is explained there that the genuine savings indicator, as usually defined and measured, tells us very little about the *ability* of future generations to sustain the present generation's welfare level. In contrast, the notions and indicators proposed in this paper are flexible enough to make it possible to incorporate a variety of sustainability targets (growth, multiple objectives). A simple classification of sustainability configurations is provided (Section “Mapping out sustainability configurations”), as well as a numerical illustration of the concepts and indicators (Section “Example”).

After these preliminaries, it is then possible to study how to incorporate sustainability indicators into a measure of social welfare, and clear decompositions are obtained which feature indexes of sustainability and unsustainability (Section “Sustainability as a component of intergenerational welfare”), as announced above.

Incorporating uncertainty in the analysis is possible, but raises a new set of issues having to do with whether the present generation just wants to check that its own welfare level is sustainable or whether a variety of welfare levels are likely to be sustainable (Section “Sustainability and risk”), with a special attention to catastrophic risks. As already mentioned earlier, a decomposition of intergenerational welfare then includes the double perspective of the risk (probability) of unsustainability and the magnitude of the setback. Another key issue is that the probability of sustaining a generational welfare level in the future must take account of the possibility for future generations to find sustained paths and to learn from the history before them. This issue is examined in detail in Section “Epistemic conditions of sustainability”.

While most of the paper deals with successive generations, it is shown in Section “Overlapping generations” that the bulk of the analysis can be adapted to overlapping generations, which is of paramount importance for applications, because annual statistics are not obviously reconcilable with the successive-generation time frame. A short conclusion is given in Section “Conclusion”.