WEAK AND STRONG SUSTAINABILITY

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Summary

Sustainable development requires economic development without endangering biodiversity, without exploiting natural resources too fast and without excessive pollution. The question is if these aims can be realized at the same time and what are the options for substitution between different types of capital. The difference between the notions of weak and strong sustainability revolves around the issue of substitutability, from a technical/physical point of view, as well as from ethical considerations. In this contribution, an overview is given of the relevant aspects in this matter. Attention is paid to standard theories of economic growth, including natural resources and the substitutability between natural resources and human-engineered capital. Also pollution is taken into account. In addition to the growth model with exogenous technical progress, also endogenous growth theory and its linkage to the sustainability debate is considered.

1. Introduction

Poverty is a pervasive phenomenon in the present world, and it has been for a long time. Also for a long time, economic growth has been seen as a remedy for solving the poverty problem. However, over the last decades of the twentieth century, it has become clear that economic growth can have negative impacts on wellbeing as well. It cannot be denied that economic growth brings along pollution, which is harmful per se, but might also damage production capacities through decreased health and the contamination of water and the soil. Moreover, the effects of climate change will probably have a negative impact.

In addition, it is argued that the economic growth has fostered the exploitation of natural resources to a degree that jeopardizes the ability of nature to regenerate them. For purely non-renewable resources, this is most apparent. People are affected differently by environmental degradation and they presently also enjoy different welfare levels. There is a huge degree of disparity between present generations in the North and South. Moreover, not only intragenerational disparities matter, also intergenerational equity is at stake. Therefore, the world is facing important challenges. In the 1980s, the concept of sustainability was prominently brought to the fore by the World Commission on Environment and Development, defining sustainability as a development that "seeks to meet the needs and aspirations of the present without compromising the ability of future generations to meet their own needs." At the same time, the Commission puts forward: "Far from requiring the cessation of economic growth it (i.e. sustainable development (CW)) recognizes that the problem of poverty cannot be solved unless we have a new era of growth in which developing countries play a large role and reap large benefits." It is the aim of the present chapter to give an overview of the approaches that the economic discipline has employed to deal with the sustainability problem.

Indeed there are various approaches possible. This is a consequence of the diversity in operationalizations of the concept of sustainability, based on differing ethical attitudes and different concepts of the interaction between the economy and the environment. It is impossible to do justice to all views, but an attempt will be made to capture the main ideas from the different approaches.

There are several aspects pertinent in any study on sustainability. Sustainability relates to the long- run prospects of an economy or, more broadly, a society, possibly including the entire world. And it has a bearing to intergenerational as well as intragenerational equity. Therefore, we need a set of feasible development paths of the economy over time and a criterion to make a choice from these paths. Usually such a criterion is defined at the level of a central planner, but of course a main concern of economists is also to design mechanisms, which will steer the individual decision-makers in the economy to realize the "optimal" path in a decentralized setting. Regarding the set of feasible trajectories the economy may follow, the traditional theory of economic growth provides a good starting point. This is not to say that it will provide all the answers, but it allows to work within a framework that is flexible enough to be extended so as to include aspects such as pollution, natural resources, technological progress and government policy. Therefore, this article starts with a brief description of the basics of the theory of economic growth in Section 2. Section 3 goes into several criteria that can be used for optimality. In Section 4 the topic of optimal economic growth is discussed. Section 5 deals with sustainability and the impact of natural resources, whereas Section 6 treats sustainability and pollution. Following the two previous Sections, Section 7 addresses weak and strong sustainability in some detail. Endogenous growth theory and its consequences for sustainability is treated in Section 8. Section 9 contains some conclusions. One preliminary remark is in order. This article does not include measures of sustainability, such as green and sustainable national income.

2. Neo-classical Growth Theory

The foundations of modern economic growth theory were laid in the 1950s, by Nobel Prize winner Solow and Swann. They considered an economy at a very high level of aggregation.

In fact there is only one production sector in the economy. This sector produces a single output. The technology can be described as follows. The output requires two factors of production, human-engineered capital and labor. The production process takes place according to a production function, describing the blueprints of production capacity for each set of inputs. It is increasing in both inputs, however at a decreasing rate for each individual input. This means, e.g. that more input of labor implies more output, but the increase of production gets smaller, the larger the input of labor. This is called decreasing returns. In effect it is also assumed that these so-called marginal products are infinitely large when the input is close to zero, and equal to zero when the input is infinity. These conditions are called the Inada conditions. When the inputs are considered jointly, it is assumed that there are constant returns to scale, meaning that if both inputs are increased by the same percentage, then output increases by the same percentage. There may occur technological progress, meaning that for given capital and labor input, the output increases over time by a certain given percentage. This is called exogenous technological progress. The output of the production process can be used for two purposes. It can be *consumed* and it can be used for *investment* purposes.

Consumption is the only source of wellbeing of the individuals in the economy. Investments increase the capital stock, thereby creating the possibility of more production, and hence consumption, in the future. It is assumed also that capital depreciates at a constant rate. The supply of labor is usually assumed to increase over time, but in the sequel, this aspect is ignored, taking a fixed and constant labor supply.

The description of the economy's technology allows for a large set of consumption trajectories, from which a choice must be made. In the original contribution by Solow, it is assumed that the consumers save a fixed proportion of their income. Then the economy will grow in the long run at a rate equal to the rate of technological progress. This growth rate applies to the output of the single commodity produced, as well as to consumption and the capital stock. It is remarkable that other parameters, such as the savings rate, do not play a role in the growth rate. If there is no technological progress, the economy will end up in a steady state with constant consumption and constant well-being per capita. This level of consumption depends on the savings rate. When the savings rate is such that the constant level of consumption is maximal, it is said that the economy follows the "golden rule."

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Biographical Sketch

Cees Withagen is professor of Environmental Economics at the Faculty of economics at the Free University Amsterdam and at the Faculty of economics at Tilburg University, both in the Netherlands. He is fellow of CentER (Tilburg) and the Tinbergen Institute (Amsterdam). His field of research is environmental economics. His present research concentrates on: the effect of environmental policy on competitiveness and location behavior of firms; natural resource economics; the economics of backstop technologies; evolutionary economics and sustainability. In the first topic, he concentrates on the relationship between international trade and environmental policy, and the Porter hypothesis. In particular, he has performed a meta-analysis of the empirical studies performed thus far. He is also active in the theoretical aspects of the policy-competitiveness linkage through general equilibrium analysis. As for natural resource economics, he concentrates on the optimal allocation of natural resources over time and studies in particular, pricing behavior models of the oil market. His research on backstop technologies is concerned with the optimal timing of the introduction of backstop technologies under alternative cost assumptions. In the final topic mentioned, he studies the applicability of concepts from evolutionary economics in questions regarding sustainability.

His papers have appeared in a number of Journals, e.g., *International Economic Review*, *Economic Journal*, *Journal of Economic Dynamics and Control*, *Journal of International Economics*, *Oxford Economic Paper*, *Journal of Mathematical Economics*, and *Energy Economics*. He participates in the project of the Dutch Science Foundation “Economics and the Environment. He is a member of a number of societies and institutions, e.g. the European Association of Environmental and Resource Economists, The Econometric Society and the Royal Economic Society.