Introduction

Guest Editor: Shunsuke Managi

This special issue of the *International Journal of Global Environmental Issues* contains a set of papers related to economic analysis on sustainable development. Given the variety of societies and institutional structures, it is commonly argued that no single approach to sustainable development is consistently useful. However, there are two commonsense propositions of sustainability that would probably command general support: First, a sustainable system must be based on resources that will not be exhausted over a reasonable period. Second, a sustainable system must not generate unacceptable pollution externally and internally.

Economics is about the efficient use of resources, usually expressed in monetary terms. In this sense, the theories regarding sustainable use of resources can be applied to sustainability. The main objective of this special issue is to provide a collection of papers in order to answer some of the main questions related to sustainable development. Some themes of the papers can be classified into

- consideration of how environmental problems affect economic growth
- implications for developing and developed countries
- empirical analysis of The Environmental Kuznets Curve
- environmental efficiency in China.

Chapter 4 of Agenda 21 identifies that: "the major cause of continued deterioration of the global environment is the unsustainable patterns of consumption and production". The sustainable consumption and production are closely related to sustainable development. For example, the Johannesburg Summit on Sustainable Development World Summit in 2002 agreed that: "changing consumption and production patterns is one of the overarching objectives of, and essential requirements for 'sustainable development"". Production and consumption technologies offer a variety of ways to transform raw materials into final goods and residuals of different characteristics. The paper by Akao and Managi impose the law of mass conservation and, as its corollary, the mass balance principle (MBP) in economic modelling. Material can neither be created from nor disappear into nothing. They explore whether environmental protection is compatible with economic growth and find that the relationship between the seriousness of environmental problems and the optimal economic growth rate is not monotonic, but hump-shaped. While optimal economic growth rate rises with the increase in the seriousness of environmental problems, there is a threshold, beyond which this relationship is reversed. They also study how the economic growth rate of the optimal sustainable development path compares to that of laissez-fair competitive equilibrium. Finally, they discuss the effects of recycling and waste abatement.

The paper by Ikazaki also analyses the economic growth and environment theoretically. Particular attention to research and development sector and education sector

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are paid to analyse environmental problems. Environmental pollution is incorporated into an endogenous growth model to examine the sustainability of growth and some properties that are related to the long-run growth rate. Private incentives of entrepreneurs to engage in research activities become the engine of growth. However, innovators do not internalise their contributions to knowledge capital. Because this causes market failure, the growth rate in a market economy tends to differ from that of the social optimum. The roles of government policy that correct market distortions are considered. If appropriate policies are enforced, government can attain the socially optimal outcome.

Global warming has become one of the most highlighted international issues of the present day. A significant dissimilarity lies between developing and developed nations in terms of their historical contributions to global warming, as well as the priorities of environmental considerations in their national agendas. Clean Development Mechanism (CDM), the implementation of the transfer mechanisms, was formally included in Kyoto protocol in 1997. The CDM is expected to contribute to the sustainable development of developing nations by promoting the introduction of cleaner-production technologies. The objective of the paper by Matsueda, Futagami and Shibata is to gain insight into the effectiveness and policy implications of these environmental transfer programs, especially, a credit-based program represented by the CDM. The provisions of financial and technological transfers are incorporated simultaneously into a dynamic game model of global stock pollution, where the efficiency in emission abatement is also described as a stock variable. Their numerical simulation indicates that a credit-based transfer program can be more beneficial for a recipient country as well as a donor country, than a non-credit-based transfer program.

The Environmental Kuznets Curve (EKC) postulates an inverse U–shaped relationship between a specific measure of environmental pollution and per capita income levels. Income elasticity of environmental degradation and resource depletion turns from positive at lower levels of per capita income to negative at higher levels. The paper by Managi utilises a larger and more globally representative sample than previous EKC studies of many pollutants and reevaluates the EKC of sulphur dioxide, carbon dioxide, nitrogen dioxide, forestry, mineral depletion, total suspended particulates, biochemical oxygen demand and nationally protected areas. The results do not find significant cases of inverted U-shape and linear term is most statistically significant in many cases including carbon dioxide. He further analyses regional level estimates of carbon dioxide and agricultural pollution, considering the EKC identification problem.

Over the last quarter of a century, China's economy has enjoyed average growth rates close to 9%. However, as a result of China's extremely rapid economic growth, the scale and seriousness of environmental problems is no longer in doubt. Whether pollution abatement technologies are utilised more efficiently is crucial in the analysis of environmental management, because it influences, at least in part, the cost of alternative production and pollution-abatement technologies. It is important to understand the performance of environmental management in order to estimate realistically the future possibility of pollution reduction. The paper by Managi and Kaneko analyses how the performance of environmental management has changed over time. Mixed results for environmental productivity are indicated using nonparametric productivity index techniques. Productivity appears to have increased with overall pollution, wastewater and water use. However, it has decreased in the case of solid waste. The case for waste gas remains relatively constant in 2003 compared with 1992, although there was some fluctuation.

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The authors of this special issue theoretically and empirically identify a number of measures that could improve the sustainability. To conclude, these contributors shed light on a number of policy issues, mainly related to the evaluations of environmental and technology policies. A growing interest has emerged during the past decade to finding the role of the governance in promoting practices that contribute to many social problems. This movement for sustainable development is gaining increasing support within mainstream economics. Sustainable development addresses many environmental and social concerns, and also it offers innovative and economically viable opportunities for community and policymakers in the entire industry system.

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