ELSEVIER

Ecological Economics 43 (2002) 159–174

ECOLOGICAL ECONOMICS

www.elsevier.com/locate/ecolecon

ANALYSIS

A sensitivity analysis of the Korean composite environmental index

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Received 4 December 2001; received in revised form 17 June 2002; accepted 29 July 2002

Abstract

The purpose of this paper is to carry out a sensitivity analysis of the Korean composite environmental index (CEI) by examining the CEIs computed by functional forms and those derived from opinion surveys, with a special emphasis on the assessment of weights of environmental indicators and themes: the CEIs are based on environmental themes and pressure indicators. The trends of CEIs had minor gaps according to survey types, survey years, and functional forms, but their effects on the CEI were not strong enough to alter the general trend, which is a clear deterioration of the environment. The Korean CEI has been deteriorating in proportion to economic growth. The annualized growth rate of real GDP and the annualized deterioration rate of environment for 1986–1997 were 7.8 and 5.6%, respectively, and a linear regression of CEI on real GDP over the same period showed a close, positive relation, specifically that a 1% growth of real GDP caused a 0.7% deterioration of the environment. The principal cause of the deteriorating environment is the priority given to economic growth over environmental preservation in the Korean drive for economic development.

Keywords: Composite environmental index; Sub-environmental index; Expert survey; Public survey; Analytic hierarchy process

Keywords: 047; Q28

1. Introduction

One of the reasons that the demand for integrated environmental information has recently increased in many countries is because integrated information is essentially used in evaluating the performance of environmentally sustainable development. As it is very difficult to evaluate the environmental performance on the grounds of so many environmental indicators, we should reduce the number of indicators by aggregating them to a composite environmental index (CEI) to make this information accessible. CEIs are very valuable as a

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0921-8009/02/$ - see front matter
PII: S0921-8009(02)00207-0

vehicle for providing environmental information in a clear and succinct manner. CEIs are especially very useful for environmental decision-making by policy makers and for maintaining well-informed public, although environmental experts may have several means for analyzing many indicators. Decision makers are much more likely to rely on integrated information such as the CEIs.

Efforts to select basic data on environmental indicators and to integrate these indicators into a CEI have been ongoing since the 1970s, but because systematic and reasonable methodologies have not been clearly formulated, CEIs have not been widely used. Prior studies have defects such as a lack of basic environmental data, deficient information on environmental and public health effects of pollutants, arbitrary selection of weights assigned to environmental themes, and a lack of rationale in the use of the CEI function.

Ott (1978) and Naito and Nishioka (1984) construct frameworks and theories for computing CEIs. Inhaber (1974), Hope and Parker (1980), Hope et al. (1992), NWF (1991), Parker (1991) and Hope and Parker (1995) compute CEIs, and Adriaanse (1993), Jesinghaus (1995a), Jesinghaus (1995b, 1997) and Puolamaa et al. (1996) develop new frameworks for CEIs using an environmental theme approach.[1] US EPA (1997) arranges the literature on environmental indices. These studies show the methods used to weigh environmental indicators and functional forms in order to aggregate sub-indices into a CEI. But Inhaber (1974), NWF (1991), Parker (1991), Hope et al. (1992) and Hope and Parker (1995), determine the selection of basic data and the seriousness of pollution materials subjectively, based on the authors' or a small number of experts' opinions. Moreover, they do not follow an environmental theme approach but rather, an environmental media approach for computing a CEI.[2]

Conversely, Puolamaa et al. (1996) use the environmental theme approach, and select environmental indicators based on materials causing environmental themes. Further, by scaling the seriousness of pollutants according to their physical impact on the environment, they employ objectivity in selecting environmental indicators and weights. But they compute sub-environmental indices (SEI) rather than a CEI, and only suggest a method for computing CEIs.

Kang (1997) and Kang et al. (1999) determine the weights of the seriousness among environmental indicators and the weights of environmental themes through an expert survey in order to overcome the limitations of Hope et al. (1992), Hope and Parker (1995) and Puolamaa et al. (1996). They compute a CEI using a weighted-sum form—one of increasing functions. But they depend solely on the expert survey for the weights of environmental themes, and compute the CEI with the weights based only on a one-time survey.

The purpose of this paper is to carry out a sensitivity analysis of the Korean CEI by examining the CEIs that were computed by functional forms and those derived from opinion surveys, with a special emphasis on the assessment of weights of environmental indicators and themes: the CEIs are based on environmental themes and pressure indicators.

[1] An environmental index based on the environmental media approach (air, water and soil) cannot effectively respond to complicated and diversified environmental themes. The environmental theme approach is far more effective in that not only are economic activities linked to the pressure of the environment, but it is also possible to devise concrete measures for solving the environmental theme.

[2] In a PSR (pressure-state-response) framework, P (pressure) indicates human activities which deteriorate the environmental state. For example, industrial activities, traffic and various pollution emissions belong to the pressure category. S (state) denotes ambient environmental states changed due to pressure factors like human activities. The concentrations of pollutants are usually included here. R (response) means the response tools of humans to control and improve a worsening environment state. For instance, the control activities, pollution control and abatement expenditure, environmental regulation and effluent charge system belong to the response category.