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An Overview of Environmental Issues Related to Transport and Industrial Sectors

Tohoku Univ. Member ○Mongkut PIANTANAKULCHAI
Tohoku Univ. Member Hajime INAMURA

1. Introduction

The failure to link the environmental system to the analysis of economic and social welfare in the past have been under heavy criticism. Economic indicators only has been criticized unable to represent the human welfare while externalities occurred. This merits the evolution of many new studies related to the environmental field and makes the environmental issues be those of the topics mostly discussed recently. Among many studies related to environment, this article focuses on the environmental issues related to Transportation and Industrial Sectors.

2. Background

Recently, the environmental issues have been more concerned as the growing of the environmental quality degradation were reported in many developing countries (Walsh, 1994). Among many sources of emission, in many studies, Transportation and Industrial Sectors have been cited as major sources of air pollution (Leontief, 1972; Sterner 1994; Lave, 1995). Among environmental concerns, in the NAMEA framework, the level of environmental concerns were classified into global environmental themes and national environmental themes. Greenhouse effect and ozone layer depletion are considered as global environmental schemes while national environmental themes include acidification, Eutrophication, waste and loss of natural resources (Haan, 1996). Past studies in this field devoted to several aspects and approaches. Among these studies, it could be classified the studies into 2 approaches, Non-Economic Interactions approach and Economic-Interactions approach.

3. Non-Economic-Interaction Environmental Studies

To develop the emission control strategies, it is necessary to the estimate the amount of emission from major sources of emissions. Emission monitors are preferred for estimating source's emission. Zhang *et al.*(1995) used remote sensing technique to measure level of automobile emissions in major cities around the world. The hierarchail cluster analysis was further applied to classify the pattern of emissions distributions and contributions of the fleets. However, the test data from individual sources are not always available and may not reflect the variability of actual emissions over time. Thus, in macro-level analysis, the emission factors are usually utilized.

In the light of macro-level estimation, Cesario (1974) developed a simple model for estimating regional automotive emissions. The classified road networks data, traffic volumes, average free-flow speed, delays were considered in the model. The model output gives the emissions(CO, HC, Nox) estimated in the study area. However, the model was not guaranteed for it's accuracy, but it could be used when rough, low-cost pollution estimates are desired.

In the United States, EPA (U.S. Environmental Protection Agency) has published many versions of procedure for estimating the emissions from various sources. Similar to Cesario`s work, Harrison(1975) used data from EPA and other organizations to estimate the costs and benefits of auto emission control program in USA. The latest version of procedure released by EPA was in 1996, called AP-42(fifth edition), which contains information on over 200 stationary source categories. This information includes brief descriptions of processes used, potential sources of air emissions from the processes. In many cases, common methods used to control these air emissions are recommended. Methodologies for estimating the quantity of air pollutant emissions are presented in the form of emission factors.

In order to recognize the trend in environmental issues, the econometric methods may be applied. Shafik(1994) formulated econometric model which indicators of environmental quality were used as dependent variable while independent variables include income(per capita), time trend(technology), site-specific(fixed effect), and the stochastic error term. The result shown the empirical relationship of income level and technology with many environmental indicators. For instance, some indicators improved with rising incomes (like water and sanitation), ohters worsen and then improve (particulates and SO_2) and others worsen steadily (like carbon emissions).

4. Economic-Interaction Environmental Studies

For macro-level analysis, in the world of economic transactions, the application of Economic-Interaction Models may be considered more applicable. As the recent heavy criticisms, in 1992, UN proposed the System for integrated Environment and Economic Accounting (SEEA) framework, so called the

Satellite System, which opened more windows to link the environment account into the core of the System of National Accounts (SNA). (Bartelmus *et al.,* 1991; Nestor and Pasurka, 1995)

In the families of multi-sectoral economic-interaction models, Input-Output Models (I-O Models) and Computable General Equilibrium Models (CGE Models) are the models that have been well applied in the environmental studies. Input-Output models assume fixed proportion of inputs and constant return to scale. The assumption of fixed-coefficients makes the general equilibrium can be solved at once by a system of linear equations. On the other hand, CGE models define a set of agents(households; firms or sectors; the government; and the rest of the world) and set of markets, and then construct supply and demand relationship for each market. The extension of these economic models allows us to include the environment into the consideration. This article will focus on the first approach, Environmental Input-Output Models.

5. Environmental Input-Output Models

Introduced first by Leontief in 1953, the I-O model have been widely applied in many economic and environmental related studies. Miller and Blair (1985, pp.236) identified three basic types of environmental I-O models.

1. Generalized I-O models involve adding extra rows to represent the generation of pollutants, and sometimes extra columns to represent pollution abatement activities.

2. Economic-ecologic models extend the I-O system by incorporating ecological commodities that are input into or residual from production and consumption processes. The basic I-O system is augmented by ecosystem submatrices that allow for flows within and between economic and ecological sectors in a manner similar to that of interregional I-O model.

3. Commodity-by-industry models incorporate ecological commodities into a commodity-industry I-O system by adding rows of ecological inputs and columns of ecological outputs.

For any given vector of final demands, the augmented I-O model can be used to find the gross output and quantities of pollutants generated by each sector to satisfy the assumptions of pollution abatement technologies, environmental quality standards at projected final demand. Other applications may include the Price Impacts Studies which estimate the impact on the price the output of all sectors if individual sectors are made to pay all or part of the cost of reducing pollution. Further study may extend to the study of the distribution of the burden of these costs among different groups in the population. (Leonteif, 1972)

The strength of I-O approach is to reveal unexpected results due to interactions in the economy. Lave et. all (1995) used I-O analysis to estimate economy-wide discharge. It was found that the indirect economic effects can not be neglected. The indirect discharges are large, generally more than twice as of the direct effect. For example, electronic computers direct discharges are very small but the indirect discharges were found 26 times larger.

In term of emissions, input-output methods are highly appropriate in case of SO_2, which are emitted by wide range of industries and seem to involve quite significant indirect pollution effects. The case seems fairly strong also in the analysis of CO. For NOx, particulates and HCs, the use of input-output may not be so easily justified (Pearson, 1989).

6.Conclusion

From many studies in the environmental related field, many models were developed as a framework for study. However, most of Non-Economic-Interaction studies depend on technology advances while Economic-Interaction studies are limited mainly by the availability and reliability of data. These limited the practical use of the models. As environmental concerns become growing, reliable data might be more available. From this trend, it will allow us to develop more reliable models and cases studies which let us to understand more the complexity of the environment and economic system.

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