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The income–pollution relationship and the role of income distribution: An analysis of Swedish household data

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Abstract

The main purpose of this study is to analyze the relationship between pollution and income at household level. The study is motivated by the recent literature emphasizing the importance of income distribution for the aggregate relation between pollution and income. The main findings from previous studies are that if the individual pollution–income relationship is non-linear, then aggregate pollution for, say, a whole country, will depend not only on average income, but also on how income is distributed. To achieve our objective we formulate a model for determining the choice of consumption of goods in different types of household. Furthermore we link the demand model to emission functions for various goods. The theoretical analysis shows that without imposing very restrictive assumptions on preferences and the emission functions, it is not possible to determine *a priori* the slope or the curvature of the pollution–income relation. The empirical analysis shows that, given the model used, the pollution–income relation has a positive slope in Sweden and is strictly concave for all three pollutants under study (CO_2, SO_2, NO_x), at least in the neighbourhood of the observed income for an average household. We also show that altering the prevailing income distribution, holding average income constant, will affect aggregate emissions in the sense that an equalization of incomes will give rise to an increase in emissions. One implication is then that the development of aggregate pollution due to growth depends not only on the income level, but also on how growth is distributed.

JEL classification: Q01; Q56; D12

Keywords: Environmental Kuznets curve; Income distribution; Household demand

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1. Introduction

The main purpose of this paper is to investigate the relationship between pollution and income at household level. The analysis is motivated by the recent literature emphasizing the importance of income distribution for the aggregate relation between pollution and income (see for example Boyce, 1994; Stern, 1998; Torras and Boyce, 1998; Scruggs, 1998; Heerink et al., 2001; Huang, 2005). For example, Heerink et al. (2001) showed that if the relationship between pollution and income is non-linear at the individual level, the aggregate pollution–income relationship will depend on income distribution in addition to income. Thus, if the individual relationship is non-linear, omitting income distribution from the aggregate analysis will produce biased results. However, no studies to date have used a structural approach to investigate the way in which individual (or household) pollution changes with economic growth. The bulk of the empirical analyses available are mostly reduced from aggregate types of studies that are unable to encompass tests of how income changes affect individual pollution via changes in the real consumption basket. Here we will address the issue on the household level by estimating a demand model for Swedish households which is directly linked to emissions of sulphur dioxide (SO_2), nitrogen oxide (NO_x), and carbon dioxide (CO_2). We will then use the result to illustrate how changes in income distribution affect aggregate emissions of CO_2, SO_2 and NO_x in Sweden.

The relationship between environmental performance and economic development has been the subject of discussion for a long time. One line of argument is that economic growth inevitably leads to more emissions and ultimately to degradation of the natural environment (Meadows et al., 1972, 1992). On the other hand it is argued that such linear relation between economic growth and environmental degradation may be a wrong description resting on too static assumptions. This latter argument can be found in, for example, Grossman and Krueger (1991, 1995), who showed that for some emissions there appears to be an inverted U-shaped relationship between emissions and income. Countries with relatively low income appear to have relatively low emissions, middle income countries have relatively high emissions, and high income countries tend to have relatively low emissions. Thus the conclusion would be that as a poor country gets richer, emissions rise. However, when income passes a certain critical level emissions start to fall. This inverted U-shaped relationship between emissions and income has been dubbed the environmental Kuznets curve (EKC).

The discovery of this potential relationship triggered substantial research efforts in this area, theoretical as well as empirical. The theoretical literature has focused mainly on the assumptions required with respect to technology/preferences and emissions for an EKC relationship to exist (Lopez, 1994; Selden and Song, 1995; McConnell, 1997; Kriström, 2000; Andreoni and Levinson, 2001). However, the bulk of the empirical literature differs substantially from the theoretical. In general the empirical models are a reduced form type using cross-country data over relatively short time periods. A typical empirical model specifies emissions as a non-linear function of income, income distribution, and a number of country specific characteristics such as population density, trade intensity and openness to trade (see Grossman and Krueger (1991, 1995) and Stern, 1998).[1] One conclusion from these studies is that openness seems to be beneficial to the environment.[2] Another conclusion from more recent studies is that using mean

[1] It may be questioned whether models of this kind should be denoted ‘‘reduced form’’ models. The reason is that a right hand shock (policy or other) affecting pollution probably affects income as well.

[2] For a survey of the empirical literature in this area, see Panayotou (2000).