Non-Homothetic Growth Models for Environmental Kuznets Curve

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Abstract

We investigate the role of η to study the environmental Kuznets curve (EKC) in several growth models, where η is the elasticity of substitution between consumption C and the service flow from the environment R in the preference, and EKC means that the environmental degradation follows an inverted U shape as income level increases. We first show that, at each income level, η determines the direction of R; that is, if η is higher (lower) than a threshold, R deteriorates (improves). This finding leads us to consider the constant absolute risk aversion (CARA) utility, in which η is decreasing in income. Indeed, we find that CARA utility exhibits EKC in a wide class of models, and the threshold for η is most strongly affected by the depreciation rates of capital and pollution stocks.

To understand the intuition behind the role of η, note first that it is natural to think that the (shadow) price of R increases as income increases, because of its limited supply. Hence, as income increases, there are two effects operating; the income effect stimulates the demand for R, whereas the substitution effect suppresses it. The former simply means that R is a normal good as a reasonable assumption, while the latter means that the demand for R decreases as R becomes more expensive. Because the substitution effect is stronger when η is high (i.e., when R can be easily substituted with C), for η high enough, the substitution effect is dominating and the environmental quality deteriorates, and vice versa. The figure below shows the simplest case with CARA utility where the environmental degradation decreases when $\eta < 1$ (see the second panel).

Setting aside EKC, this finding implies that, the actual value of η for income high enough and its threshold is the key to predict the long-run fate of R. In this respect, not surprisingly, our sensitivity analyses suggest that a class of pollutants that show a low depreciation rate (i.e., the nature can purify them only slowly) are less likely to decrease in the long-run; one such example is CO_2.

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Figure 1: A model for flow pollutants without capital stock