

Environmental Kuznets Curve

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Empirical Question

- ▶ Environmental inputs are important to the economies of many [developing] countries
- ▶ Dirty production methods are cheaper than clean production methods

Question: Is there a point where further economic prosperity leads to improving environmental quality?

Empirical observation: There exists an inverted U-shaped relationship between a variety of environmental indicators and economic variables

Background

1. EKC named after Simon Kuznets who hypothesized income inequality first rises then falls with economic development
2. EKC emerged mostly from work by Grossman and Krueger (1990) – studying potential impacts of the North American Free Trade Agreement (NAFTA)
3. Concern that increased economic activity in a ‘dirty’ country would lead to increase in pollution

Graphical Observation

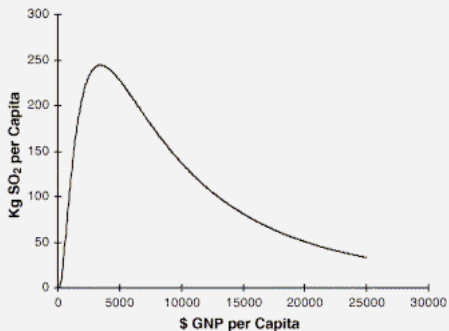


Figure: Environmental Kuznets Curve

Components / Reasons for EKC

1. Scale of production – economies of scale exist in production that either
 - 1.1 require ‘dirty’ inputs at first levels of production so average pollution falls with increased output
 - 1.2 pollution controls may not be feasible or practical at low levels of output but are at higher levels of output
2. Output mix changes – in early stages of development shift from ag to heavy industry, which increases emissions. Then transition to services and light manufacturing with fewer emissions
3. Input mix changes – higher income allows switching to cleaner inputs, e.g., from coal to natural gas
4. State of technology improves
 - 4.1 productivity improves leading to fewer inputs needed
 - 4.2 emissions specific changes in process

Which force is stronger?

- ▶ The question is whether these forces are stronger than the straight 'production requires emissions' problem.
- ▶ EKC is largely a data phenomenon.

Econometric Framework

$$\ln\left(\frac{E}{P}\right)_{i,t} = \alpha_i + \gamma_t + \beta_1 \ln\left(\frac{GDP}{P}\right)_{i,t} + \beta_2 \left[\ln\left(\frac{GDP}{P}\right)_{i,t}\right]^2 + \epsilon_{i,t}$$

$$\frac{\partial \ln(E/P)}{\partial \ln(GDP/P)} = \beta_1 + 2\beta_2 \ln(GDP/p)$$

Let τ denote the maximum $\frac{GDP}{P}$

$$0 = \beta_1 + 2\beta_2 \ln(\tau)$$

$$\tau = e^{-\beta_1/2\beta_2}$$

Empirical evidence

Tables 1 and 2 from “The Rise and Fall of the Environmental Kuznets Curve” by David Stern, World Development (2004)

Why EKC studies are important

1. EKC is a testable / falsifiable hypothesis
2. Poses an important intellectual challenge
 - ▶ effect of structural economic change on use of environmental and resource inputs
 - ▶ affect of increasing income on demand for environmental quality
 - ▶ highlights types of environmental degradation and ecological processes, and their comparability

Other empirical evidence

1. When EKC relationships do hold, they seem to be mostly for short-term to local pollutants. Not global and longterm.
2. With regard to local pollutants, may hold for some air quality measures, not for water quality measures
3. Significant variation of findings between countries
4. When EKC turning point estimated, usually high relative to actual incomes
5. Even per capita reductions don't mean total reductions considering rapid population growth in developing countries

Theoretical Critiques of EKC

1. Usually assumed that there is no feedback between environmental damages and economic development - income is assumed to be an *exogenous* variable. If environmental quality matters for growth, rapid production with dirty processes is unsustainable.
2. In developed nations, reductions in one pollutant seem to be replaced by other pollutants in the production process. Per capita pollution and waste has not fallen. Misleading to look at only one pollutant.

Theoretical Critiques of EKC (cont.)

3. Effect of trade – under free trade, countries specialize in goods that are intensive in factors that are more abundant. For developing countries this means labor and natural resources. Cleaner developing countries may be a *result* of this specialization - as these countries become wealth, there is no poorer country to send their dirty production to.
4. Most of these results are cross-sectional. We don't have data on individual countries

What the EKC is Not

- ▶ The EKC discussion is different than the discussion of whether our focus should be on environmental vs. humanitarian goals (malaria vs. climate change).
- ▶ It is also different than environmental quality as a luxury good, which has largely been debunked