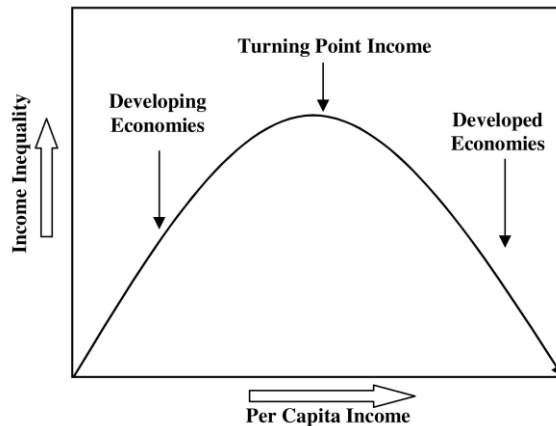


Part II - ENVIRONMENTAL KUZNETZ CURVE

mostly based on: **Yandle, Vijayaraghavan, Bhattarai, The Environmental Kuznets Curve: A Primer.**

[additional reading: **Stern, The Rise and Fall of the Environmental Kuznets Curve** which is quite technical, you might still want to read at least the non-technical parts]

Kuznets (1955) hypothesized that income inequality first rises and then falls with economic growth – inverted U shape - hence the name EKC (Environmental Kuznets Curve) for similar pattern in environmental policy



1. EKC first reported in 1991

- Grossman and Krueger's analysis of air quality measures
 - a cross-section analysis of countries for different years,
 - investigating the claim that economic growth accompanying the NAFTA would foster environmental degradation
 - the authors identified a turning point beyond which with higher income air quality started to improve (for two indicators SO₂ and dark matter(smoke)),
- EKC has become standard fare in technical conversations about environmental policy
- the theoretical framework is still in early stages (see e.g. Lopez 1994 or Munasinghe 1999, in Yandle et al.)

What is the basic issue?

- Can economic growth be the means to *eventual* environmental improvement?
- Can humankind “have our cake and eat it” – a prospect of achieving sustainability without a significant deviation from business (Rees 1990, p. 435, in Stern)
- Does the following result (of an “inverted U-shaped function of income per capita”) generalize to other emissions?

1420

WORLD DEVELOPMENT

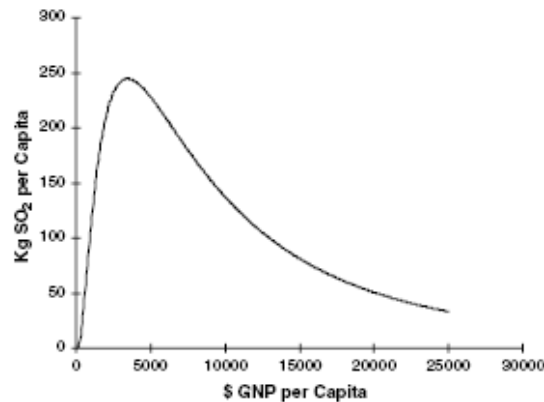


Figure 1. *Environmental Kuznets curve for sulfur emissions. Source: Panayotou (1993) and Stern, Common, and Barbier (1996).*

Yandle et al

- Where did the name “Environmental Kuznets Curve” come from?
- Why Kuznets?
- What have we learned about the statistical relationships between various measures of environmental quality and income?
- Do all aspects of environmental quality deteriorate or improve systematically with economic development?
- Does the degree of property rights and contract enforcement make a difference?

So what is the intuition?

1. At the low levels of per capita income

- typical for pre-industrial and agrarian economies, not very industrialized
- rather pristine environmental conditions, relatively unaffected by economic activities (i.e. relatively low “industrial” pollution)
- **as development and industrialization progress, environmental damage increases due to greater use of natural resources, higher emission of pollutants, the operation of less efficient and relatively dirty technologies,**
- also, typically, high priority is given to increases in material output with disregard for the environmental consequences of growth.

2. As economic growth continues (and life expectancies increase)

- cleaner water, improved air quality, and a generally cleaner habitat become more valuable
- Much later, in the post-industrial stage, **cleaner technologies and a shift to information and service-based activities combine with a growing ability and willingness to enhance environmental quality** (Munasinghe, 1999)."

“Saying all this may tempt one to think that higher incomes alone will solve most environmental problems. Unfortunately, life is not that simple. If it were, transfers of income from richer to poorer societies—through foreign aid, for example—would enable the recipients to avoid environmental destruction.”

3. ***“The movement along an environmental Kuznets curve is also a movement through a well-known set of **property right stations!**”***

- In primitive societies managed by tradition or tribal rule, part of the resource base may be treated as commons.
- With growing scarcity, however, a time comes when some aspects of the commons become defined as public or private property.
- As “property-ness” expands, individuals have a greater incentive to manage, to conserve, and to accumulate wealth that can be traded or passed on to future generations. ...

“Thus, the Environmental Kuznets Curve is a proxy for a property rights model that begins with a commons and ends with private property rights.”

4.

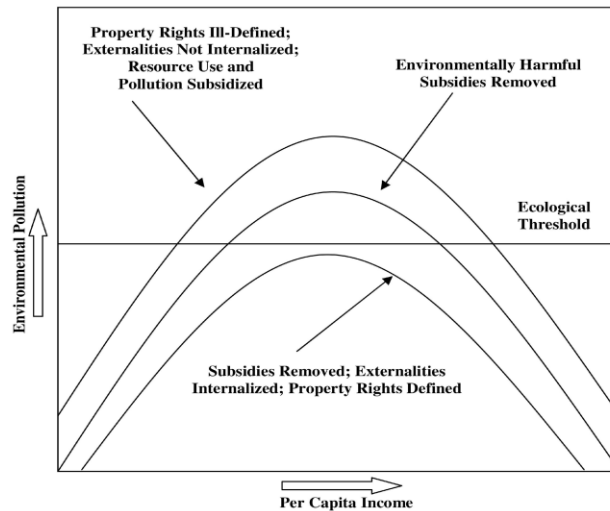
Empirical Evidence:

- Grossman and Krueger 1991 – identified the turning point for **SO₂** and **dark matter**
- Shafik and Bandopadhyay (1992) – for **SO₂, suspended particulate matter, fecal coliform** [a bacteria - its aerobic decomposition can reduce dissolved oxygen levels if discharged into rivers or waterways]
- Hettige et al 1992 - using a composed production toxicity intensity index – found EKC for toxic intensity per GDP, not for “per manufacturing output”... Manufacturing, which is just one part of GDP, did not become cleaner or dirtier as income changed. Instead, **manufacturing became smaller relative to services and trade in expanding economies. ... This could mean that dirty production shifts elsewhere!!!** They found that “toxic intensity in manufacturing has grown much more rapidly in economies that are relatively closed to international trade”
- Suri and Chapman (1998) - focused on energy consumption showed **that as industrialized economies matured, they moved to services and then imported more manufactured goods from developing countries** -> the global diffusion of manufacturing contributes to local environmental improvements as incomes rise and development continues
- Gokany 2001 – “**Open economies improve their environments**” (another evidence of positive impact of international trade?)
- Cropper and Griffiths (1994) – as income increases the rate of **deforestation levels off**
- Panayotou (1995) – finds that the **turning point for deforestations occurs much earlier than for emissions,**” because deforestation for either agricultural expansion or logging takes place at an earlier stage of development than heavy industrialization”
- Shafik (1994) – studied four determinants of environmental quality -> **mixed results**
- Grossman and Krueger (1995) – more extensive empirical study, **focusing on water quality , found a turning point for 11 out of 14 selected indicators**
- following up, Selden and Song (1994) – 2 G&K’s air pollutants + oxides of nitrogen and carbon monoxide – found EKC for all 4, turning points for pollutants from G&K are significantly higher than G&K’s estimates (they use readings from both urban and rural areas, G&K only urban)
- Cole et al – examined a wide range of indicators for different countries

and specifically on **property rights...**

- Panayotou (1997) examining EKC for sulfur dioxide found that faster economic growth and higher population density do increase moderately the environmental price of economic growth, but

better policies such as more secure property rights under a rule of law and better enforcement of contracts and effective environmental regulations can help flatten the EKC and reduce the environmental price of higher economic growth. Similar results obtained by Qin (1998), and Bhattarai (2000)



Conclusion

- there is no single EKC relationship that fits all pollutants for all places and times
- The indicators for which the EKC relationship seems most plausible are local air pollutants such as oxides of nitrogen, sulfur dioxide, and particulate matter.
- there is no evidence to support the EKC hypothesis for gases such as carbon dioxide, which cause no harm locally but may affect the global climate as they accumulate in the atmosphere
- the evidence for water pollution is mixed
- better policies and enforcement can help to flatten ECK and perhaps to achieve an earlier turning point.

A Critique of EKC - Stern, The Rise and Fall of the Environmental Kuznets Curve

- currently, a dispute over methodology and the reality of the EKC – theoretical and econometric critique of EKC literature
 - recent evidence suggests that developing countries are addressing environmental issues, adopting high standards (of developed countries) and sometimes performing better than some wealthy countries
 - “most of the EKC literature is **econometrically weak**” (Stern p. 1420) because it does not account properly for the statistical properties of the data used [serial dependence, stochastic trends] and issues of model adequacy [possibility of omitted variable bias]
 - “**when we ... use appropriate techniques, we find that the EKC does not exist**” (Stern p. 1420)

- “e.g., it is clear that **emissions of many pollutants per unit of output have declined** over time in developed countries with increasingly stringent regulations and technical innovations. But the mix of residuals has **shifted** from sulfur and nitrogen oxides to carbon dioxide and solid waste... so that **per capita waste (total) might not have declined...**”
- ... “an effort to reduce some environmental impacts may just aggravate other problems.”
- “It seems that emissions of most pollutants and flows of waste are monotonically rising with income”, though the “income elasticity” is less than 1 and is **not a simple function of income alone** -- other factors, income independent or **time related** effects [such as **institutional quality**] reduce environmental impacts in all countries at all levels of income” (Stern p. 1420))
 - In rapidly growing middle-income countries, **scale effects tend to dominate time effects**
 - **Pure growth, without change in the structure or technology of an economy, leads to more pollution and other negative environmental impacts (scale effects)**
 - As economies grow, **output mix changes** – from more pollution intensive to less pollution intensive industries -- input mix changes, emission specific regulations might change
 - In wealthy countries, time effects can dominate scale effects (partially because growth is slower)
- Arrow et al. (1995) and Stern et al. (1996) argue that EKC relationship (if there were any) might be partly or largely a result of **the effects of trade** in the distribution of polluting industries (developed countries specializing in human capital and manufactured capital intensive activities that might to some extent explain reduction of environmental degradation in those countries)... no consensual answer on the impact of trade in EKC literature
- currently, also a dispute over the appropriate mix of econometrics /statistics and theory, as well as the facts
 - “many environmental economists take the EKC as a stylized fact that needs to be explained by theory.” (Stern p. 1421)
 - **“the EKC has never been shown to apply to all pollutants or environmental impacts”** (Stern p. 1421)
- A number of theoretical models have been developed on how preferences and technology interact to result in different time paths of environmental quality. (Stern p. 1422)
 - Most of these studies can generate an inverted U-shape curve of pollution intensity but ... but the results are assumption and parameterization sensitive
 - Many studies also include additional explanatory variables,
 - intended to model underlying factors such as ‘political freedom’, or output structure, or trade
 - these factors, in general, turn out significant at traditional levels. ...
 - it is not clear what we can infer from this body of work because of potential for omitted variable bias
- Turning point estimates differ widely (see Table 1, Stern p. 1425):

- **“The only robust conclusions from the EKC literature appear to be that concentrations of pollutants may decline from middle income levels, while emissions tend to be monotonic in income. ... “** (Stern p. 1426)
- “It seems unlikely that the EKC is an adequate model of emissions or concentrations. I concur with Copeland and Taylor (JEL 2004), who state that: **“Our review of both the theoretical and empirical work on the EKC leads us to be skeptical about the existence of a simple and predictable relationship between pollution and per capita income.”** (Stern p. 1435)