ECON B225: ECONOMIC DEVELOPMENT

Sebastian Anti,
Assistant Prof. of Economics, Bryn Mawr College

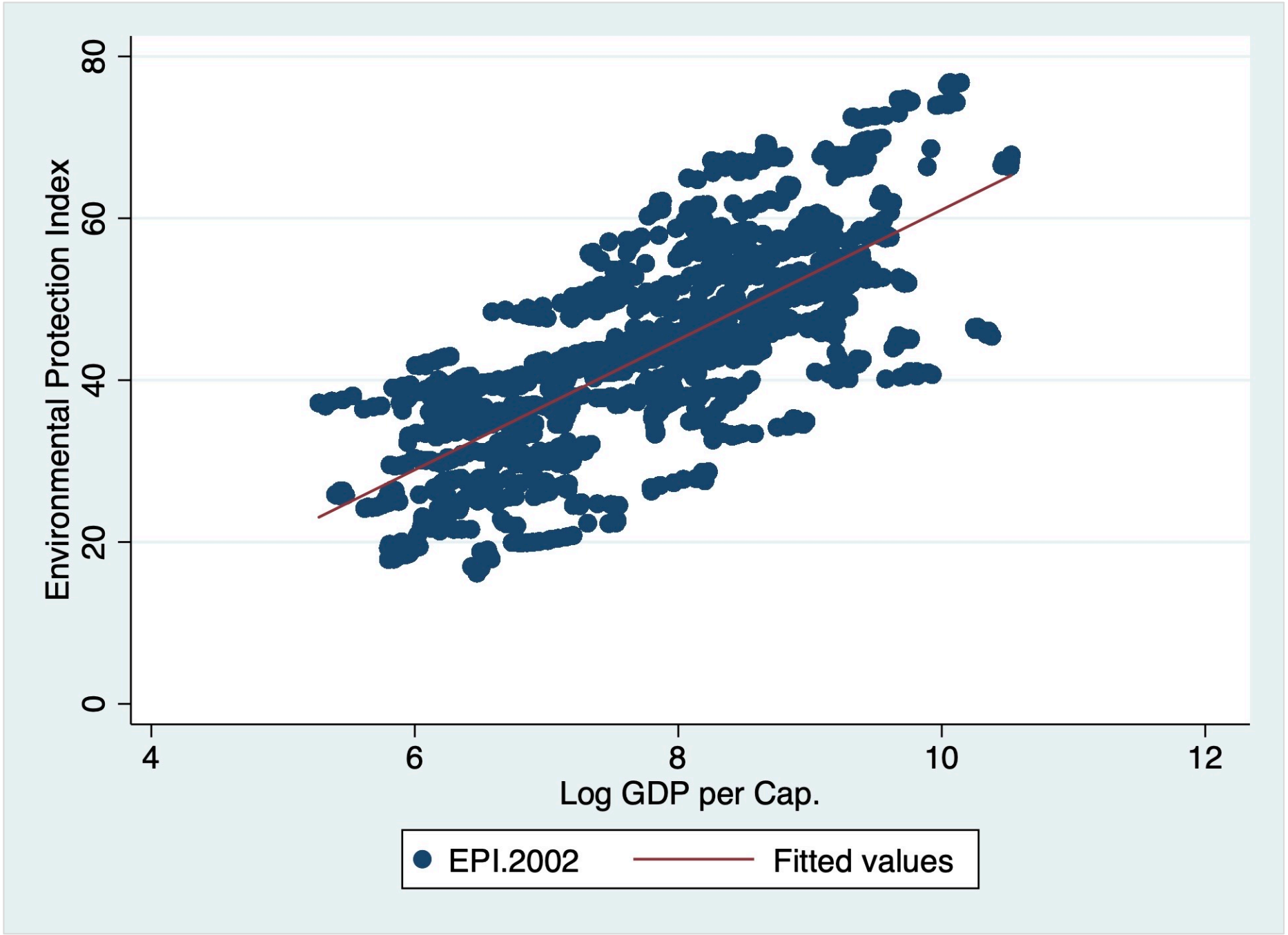
Development and the Environment

Basics: Economic Growth in Tension with Preservation

- **Economic growth puts two competing forces on the environment:**
  - (1) Growth demands more resources and produces waste
    - Generally a force that degrades the environment
      - Deforestation
      - Industrial contamination
      - Climate change
  - (2) Growth produces innovation and efficiency
    - Efficiency can reduce pressure on the environment
      - Agricultural land that's more productive means less incentive to expand into the forest
    - Innovation to avoid waste
      - Electric cars

Basics: Changing Preferences for Environmental Preservation

- **Hypothesized U-shaped relationship between development and environmental degradation**
  - Low income drives people to natural resource extraction and short-run approaches to production, straining the environment
  - As income goes up, technology improves and people begin to appreciate a better environment ("positive income elasticity of demand for environmental services")
  - Called the "Environmental Kuznet's Curve"


Environmental Protection Index
0
20
40
60
80
4
6
8
10
12
Log GDP per Cap.
EPI.2002
Fitted values

Implications

- **Just wait for income to go up and environmental destruction will stop? No**
  - U-shape only shown for a "few air and water pollutants", not resource stocks or carbon emissions
  - Possible to have irreversible environmental damage in the process of achieving that higher income level
  - Also, perhaps environmental damage is just displaced to the poorer countries
    - See the Copeland and Taylor model for a formal exposition of this idea
    - Implication: income inequality needs to also be addressed before this is a "solution"

Environmental Econ: Theory

- **Economists generally think of environmental resources are a type of "common" property**
  - This means it is not exclusive to any individual
  - It is accessible to everyone in society
- **Examples: Air, water, fish stocks, a forest**
  - Some of these could be made excludable: pieces of a forest could be parceled out and bought
  - But others, like the atmosphere is simply not something at any one person or the govt. controls

Environmental Econ: Theory

- **Environmental destruction occurs through the "Tragedy of the Commons"**
  - With no regulation, individual actors maximizing their utility using the common property resource will degrade it and eventually destroy it
  - This is essentially formalizing the idea that if too many people use a resource there's a risk of over using it and destroying it

Solutions to the Tragedy of the Commons

- **First Solution: Privatize the Resource**
  - This basically removes the open access nature of the resource which partially drives the tragedy of the commons situation
    - Owners of the resource will have an incentive to maintain it, and they can exclude others from using it by enforcing property rights
  - Downsides:
    - Excludes poor people from the resource with potentially terrible consequences
    - If owner doesn't value having the resource in the future then they will also destroy it ("high time-discount rate")
    - Some resources can't be privatized (the atmosphere for example)

Solutions to the Tragedy of the Commons

- **Second Solution: Ownership by the state**
  - Government represents collective interests, so have the govt. own and administer the resource for the benefit of all
    - The state often has vast resources and technical expertise to manage these natural systems
  - Downsides:
    - Becomes subject to elite capture and exploitation by politically enfranchised people
      - Evidence from colonial exploitation

Solutions to the Tragedy of the Commons Example

- ***Seeing Like a State* by James C. Scott**
  - James C. Scott is a political theorist at Yale with some useful insight here
  - **Basic argument:** The State needs to administer vast resources. In its effort to make its tasks legible and manageable, it needs to "abstract", or simplify its understanding of, its subjects. This process of abstraction can lead to terrible outcomes for the subjects under the state's authority
  - **Example:** Forests in Imperial Germany

Seeing Like a State Example

- **Imperial Germany sought to reforest an area that had been deforested over some period of time**
- **It "abstracted" the forest to something like the following:**
  - A source for wood available for ship building and other needs related to commercial interests and national security
  - Scott "From a naturalist's perspective, nearly everything was missing from the state's narrow frame of reference. Gone was the vast majority of flora…Gone were most species of fauna, except those that interested the crown's game keepers."

Seeing Like a State Example

- So the state has made its task more straightforward or "legible": plant a bunch of trees
- But this produces a tree farm, not a forest
- The result was nothing like a forest

Solutions to the Tragedy of the Commons

- **Third Solution: Local Community Management**
  - Places decision making in control of people that have knowledge of the resource and derive the most benefit from it and thus have motivation for its well-being
    - Elinor Ostrom earned the Nobel Prize in Economics for her work showing this is possible
    - Also many instances of failures
  - **Obvious question:** How does a collection of people making up a community cooperate to sustain a natural environmental resource?

Dynamics of Cooperation

- **Application of Game Theory**
  - Game theory is the branch of economics that deals with systems where agents practice some sort of "strategic" behavior, or behavior that takes into account the actions of others
  - It can help us analyze how systems produce outcomes that are optimal or the agents in the system or sub-optimal is some sense
  - Cooperation is a type of strategic behavior that occurs under certain conditions

Basic Understanding: The Prisoner's Dilemma

		Player 2	
		Cooperate	**Defect**
Player 1	**Coop.**	-1, -1	-3, 0
	Defect	0, -3	-2, -2

- **Assume no coordination by the players**
- **Outcome of this game:**
  - Both players will always choose to defect. Why?
    - If player 1 cooperates then player 2's best move is to defect.
    - If player 1 defects, player 2's best move is to defect.
    - So player 1 assumes player 2 will defect. Under this assumption player 1's best move is to defect.
    - The game is symmetric, so player 2 comes to the same conclusion
    - Hence, both defect

Basic Understanding: The Prisoner's Dilemma

		Player 2	
		Cooperate	**Defect**
Player 1	**Coop.**	2, 2	-1, 1
	Defect	1, -1	0, 0

- **Perhaps payoff structure results in sustained cooperation**
- **Outcome of this game:**
  - Both players will always choose to cooperate. Why?
    - If player 1 cooperates then player 2's best move is to cooperate.
    - If player 1 defects, player 2's best move is to cooperate.
    - So player 1 assumes player 2 will cooperate. Under this assumption player 1's best move is to cooperate.
    - The game is symmetric, so player 2 comes to the same conclusion
    - Hence, both cooperate!

Too Simple? Systems with Multiple Actors

- **These models can become more complex and incorporate multiple actors**
- **Basic Takeaway:**
  - More actors that participate make an individual's cooperation more likely
    - Aligns with intuition of going along with the crowd or bandwagon behavior
    - Implies that leadership can have a role in the process if it effectively encourages or discourages more people to participate

Some Useful Generalities

- **Stepping out of the model, think about what makes groups better and worse at cooperation**
  - Size: small groups cooperate better
    - Monitoring is easier, more likely members hold common knowledge and assumptions, more likely to share incentives, more knowledge and insight into each other's actions
  - Migration: movement undermines cooperation
    - Contact with others and exit options diminish common social norms, prolonged experience with cooperation ("repetition of the game") is harder
  - Communication: less ability to communicate undermines cooperation
    - Same mechanisms as size above

Grossman and Kruger (1995)

- **Research Question:** Does economic growth have a relationship with environmental degradation? If so, what is its shape?
  - **Reasons to think the effect is negative:**
    - Growth requires natural resources
    - Production produces waste
  - **Reasons to think the effect is positive:**
    - Growth produces innovation and efficiency
    - As people gain income they are less interested in basic survival and start to care about environmental preservation

Data

- **Dataset is a station-level panel dataset**
- **From the Global Environmental Monitoring System (GEMS)**
  - Air quality
  - Water quality
- **Control variables from various sources**

Empirical Strategy

- **They estimate this equation:**

$$Y_{it} = G_{it}\beta_1 + G_{it}^2\beta_2 + G_{it}^3\beta_3 + +\bar{G}_{it-}\beta_4 + \bar{G}_{it-}^2\beta_5 + \bar{G}_{it-}^3\beta_6 + X_{it}'\beta_7 + \varepsilon_{it}$$

Country GDP **Country GDP squared** **Country GDP cubed** **Controls**

- **The higher order terms allow for more flexible functional form relationship between GDP and environmental outcome**

Results: Air Pollution

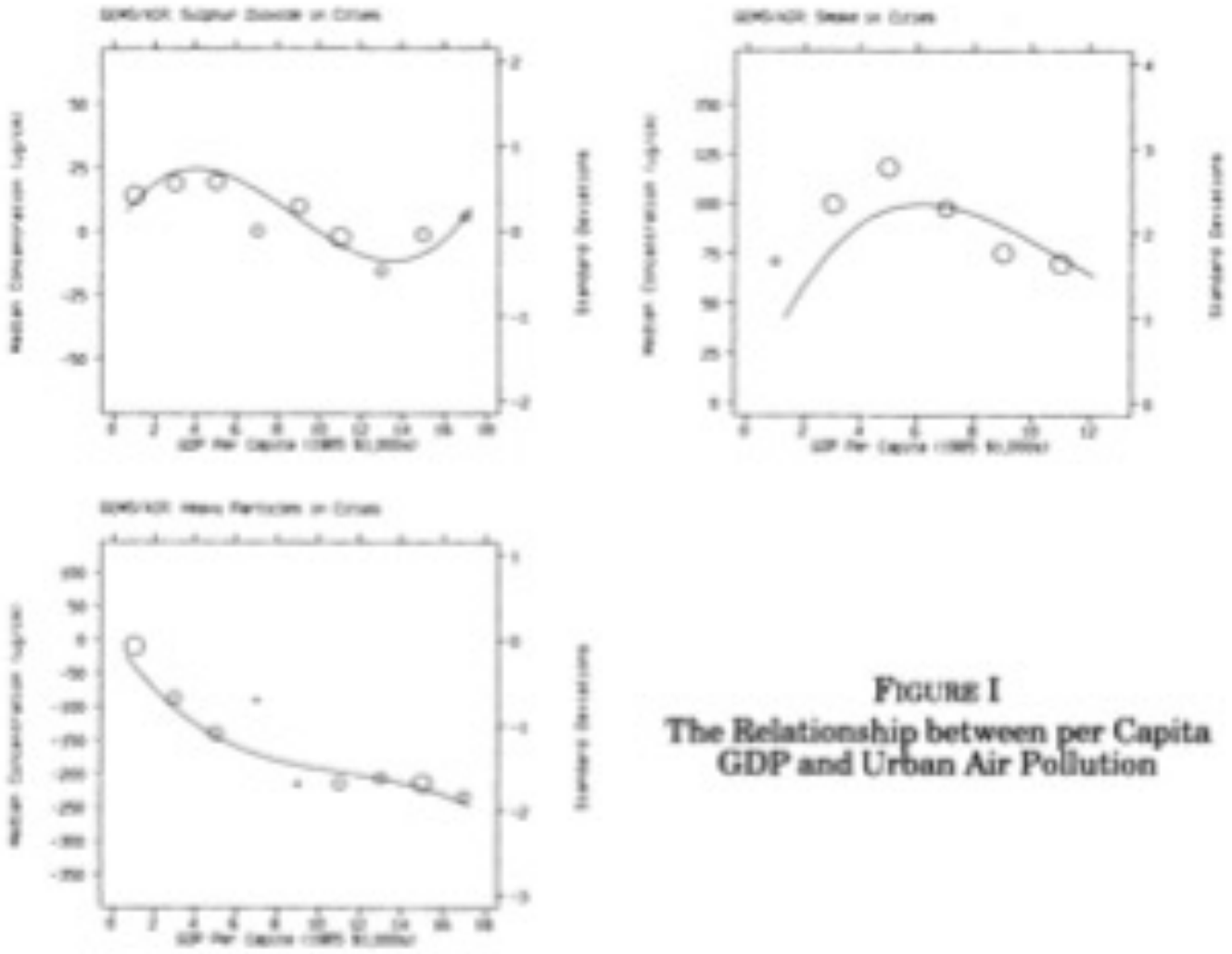


FIGURE I
The Relationship between per Capita GDP and Urban Air Pollution

Results: Oxygen in Water

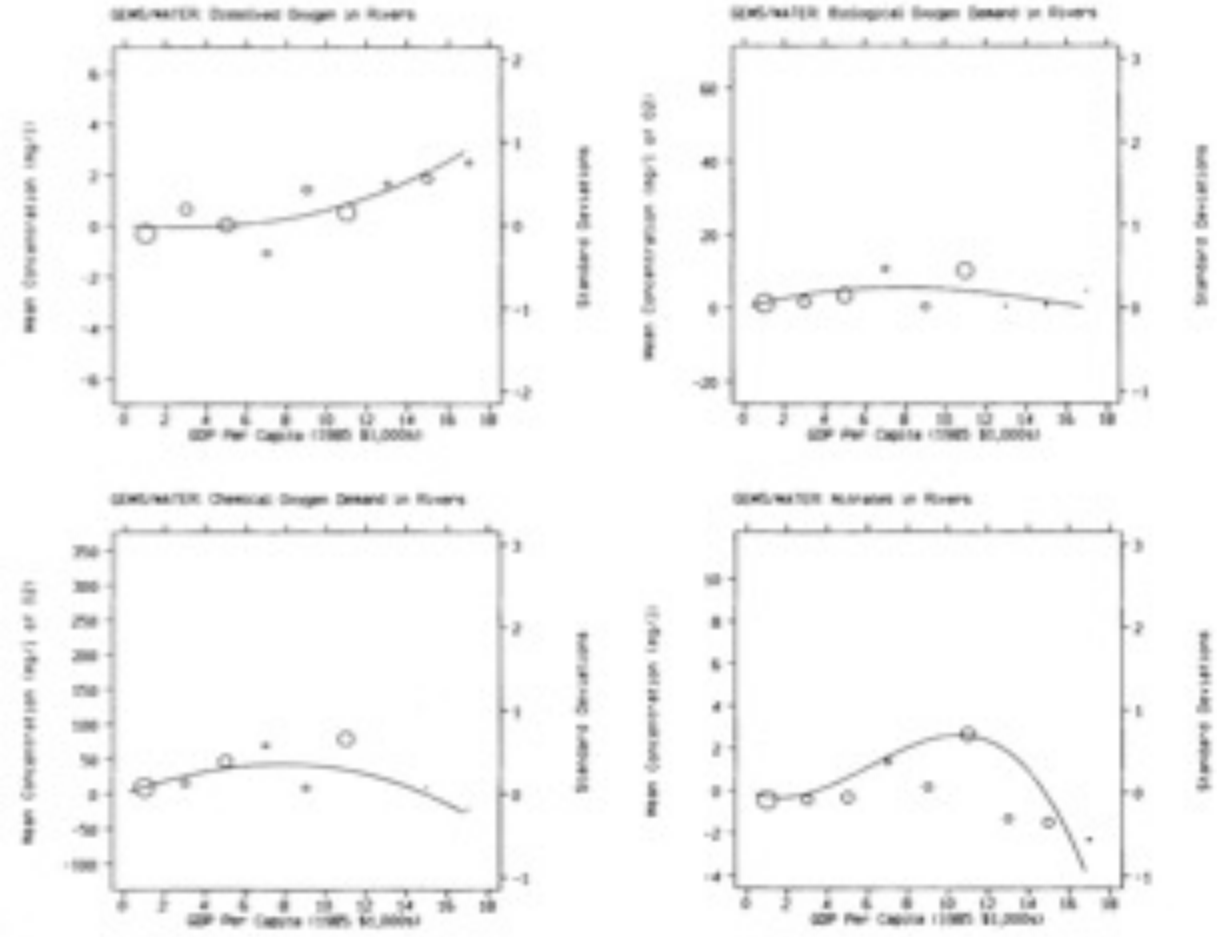


FIGURE II
The Relationship between per Capita GDP and the Oxygen Regime in Rivers

Fecal Contamination in Rivers

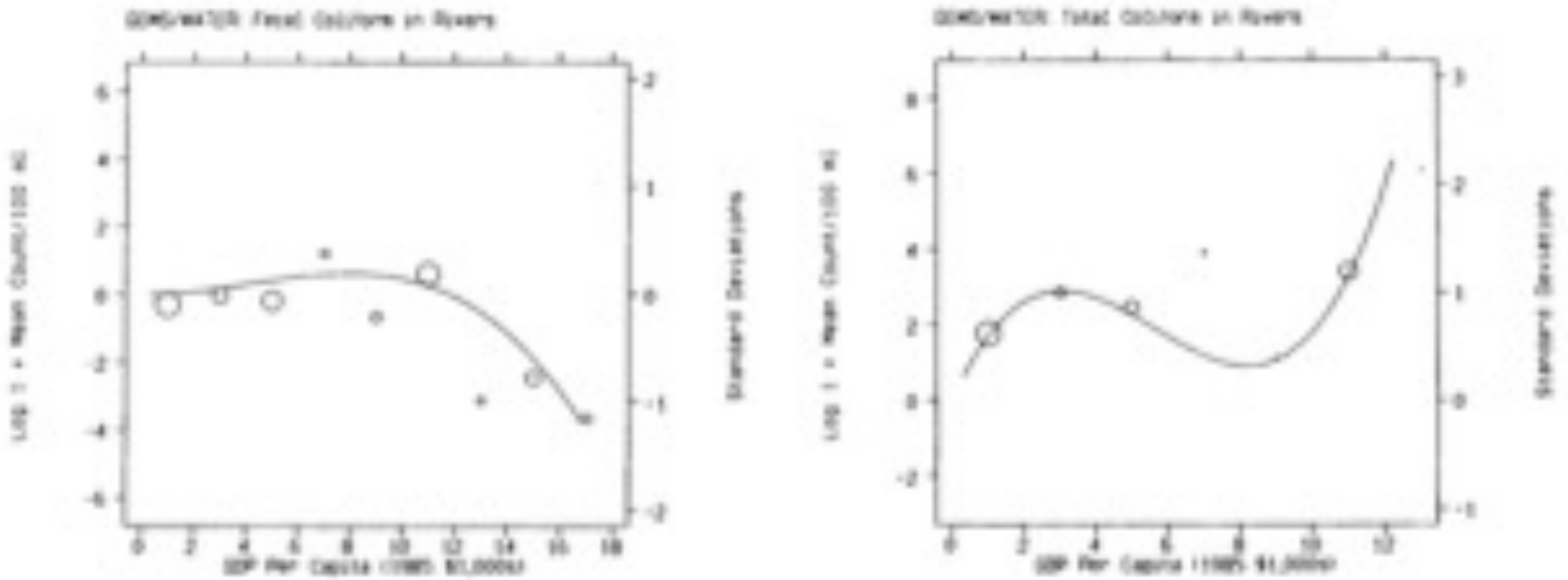


FIGURE III
The Relationship between per capita GDP and Fecal Contamination of Rivers

Results: Metals in Water

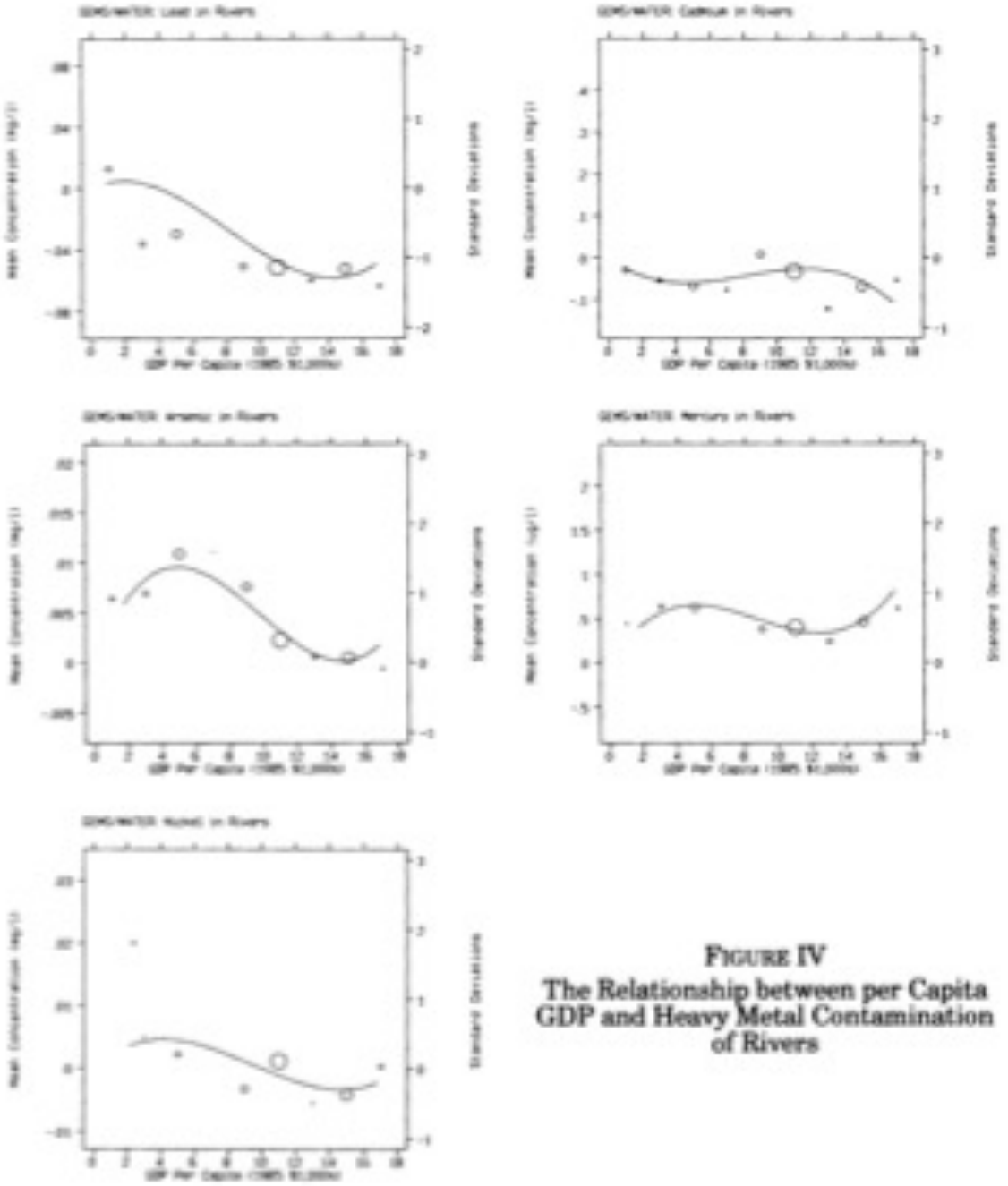


FIGURE IV
The Relationship between per Capita GDP and Heavy Metal Contamination of Rivers

Takeaway

- **Looks like there is evidence of an environmental Kuznet's curve for these particular measures**
  - Note: further research has found this does not hold for other environmental measures. It might be useful to think about why
- **Good example of a study that shows an interesting and useful correlation**