Economic Growth and Land Use Change: Does an Environmental Kuznet's Curve Exist?

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Outline

- Introduction
- Development and Sustainability
- The Environmental Kuznet's Curve (EKC)
- Results of Pilot Study
  - Available Data
  - Proposed Methodology
- Conclusions

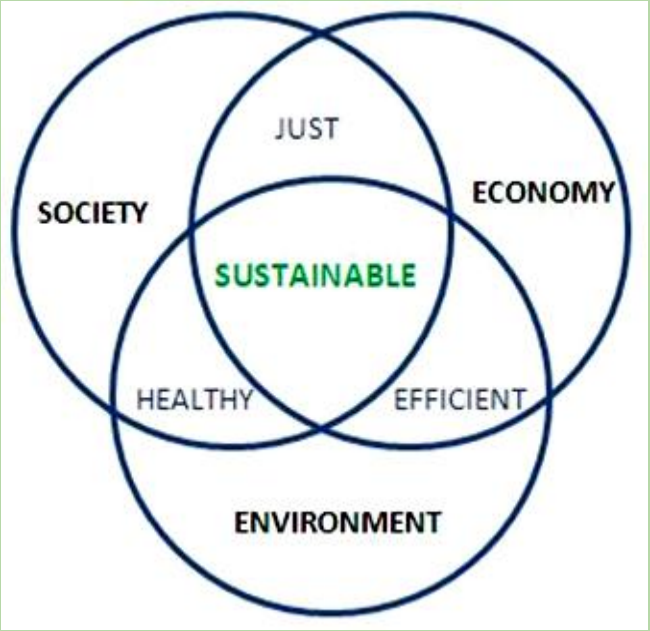
Introduction

Broad Research Question

- How do economy and environment interact?
- How can we approach this using GIS?

Narrower Question

- How have land use/cover changed as a result of economic activity?



http://mncompact.files.wordpress.com/2010/11/sustainability.png

Traditional Development

Traditional economics

- Natural resources converted to marketable goods and services
- Economic growth must occur to pay loan interest
- Maximize output,Minimize input (social and material)
- Externalize costs- environment suffers
- If all things constant, need an inexhaustible supply of natural resources to sustain growth

Complex interaction between consumption of natural resources, economic growth and environmental impacts

Sustainable Considerations

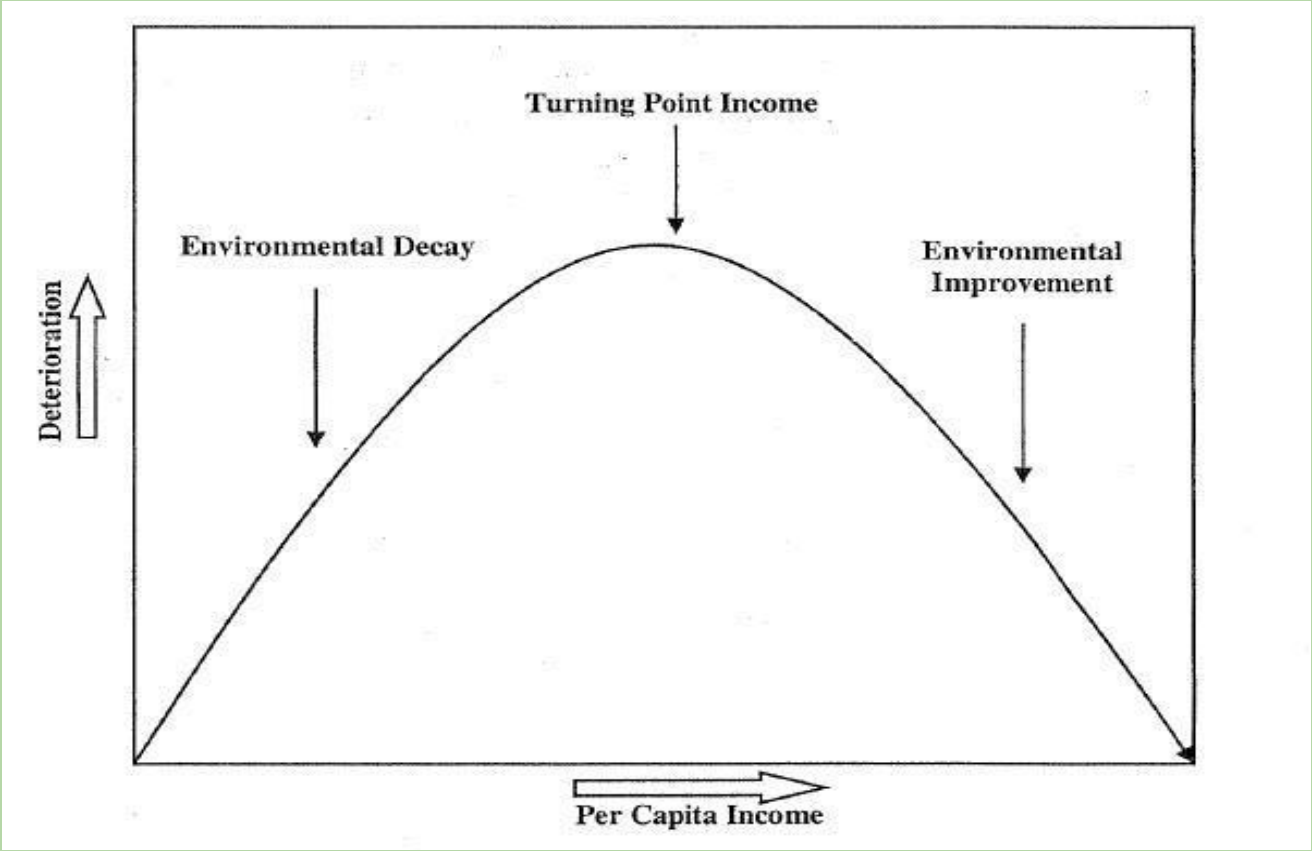
Hypothesized that rates of economic growth and per capita income do not linearly correlate with various forms of environmental degradation (Kuznet 1955)

Linear relationship assumes constancy of:

- Technology
- Social Preferences
- Environmental Investment

The Environmental Kuznet's Curve

Instead of linear, an inverted-U pattern should emerge

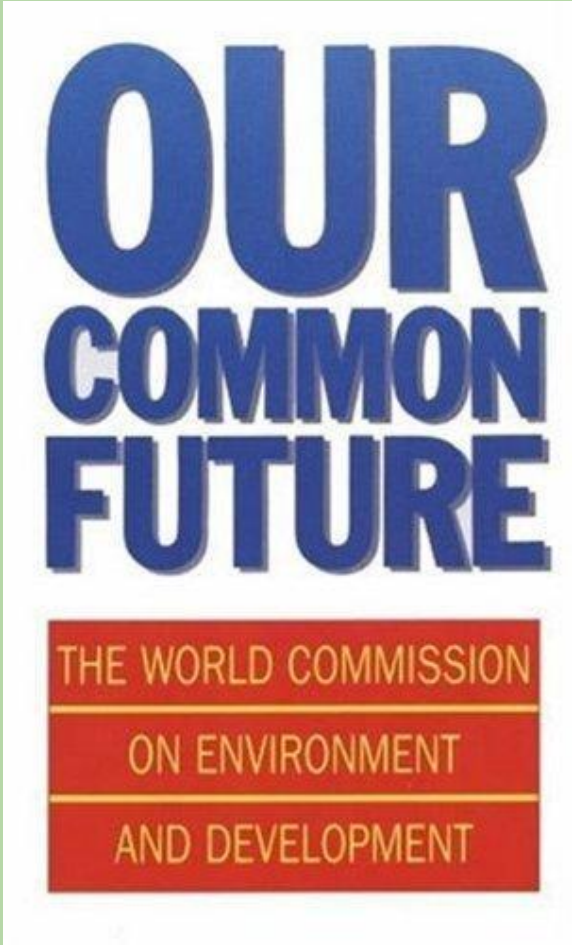


http://thepercolatorblog.files.wordpress.com/2011/02/environmental-kuznets-curve.jpg

Sustainability Considerations

For the sake of sustainable development, we hope an EKC exists for most factors, if it doesnt...

- Bruntland Commission Report (1987): "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*



http://ecx.images-amazon.com/images/I/41L3JE-39hL.jpg

EKC evidence

So, do we actually see this?
Depends on

- Scale, Time and the Environmental Factor (Drummond and Loveland 2010, Bo 2011)

Scale: **Yes**: small scale **No:** large scale (mostly)
Time: Now: No for CO_2, in 100 years, maybe
Factor:

- Yes: Sulfur Dioxide, Nitrous Oxide (results of fossil fuel burning)
- No: Biodiversity (Dietz and Adger 2003)
- Depends/Don't Know: Deforestation (Koop and Tole 1999) and Land Use

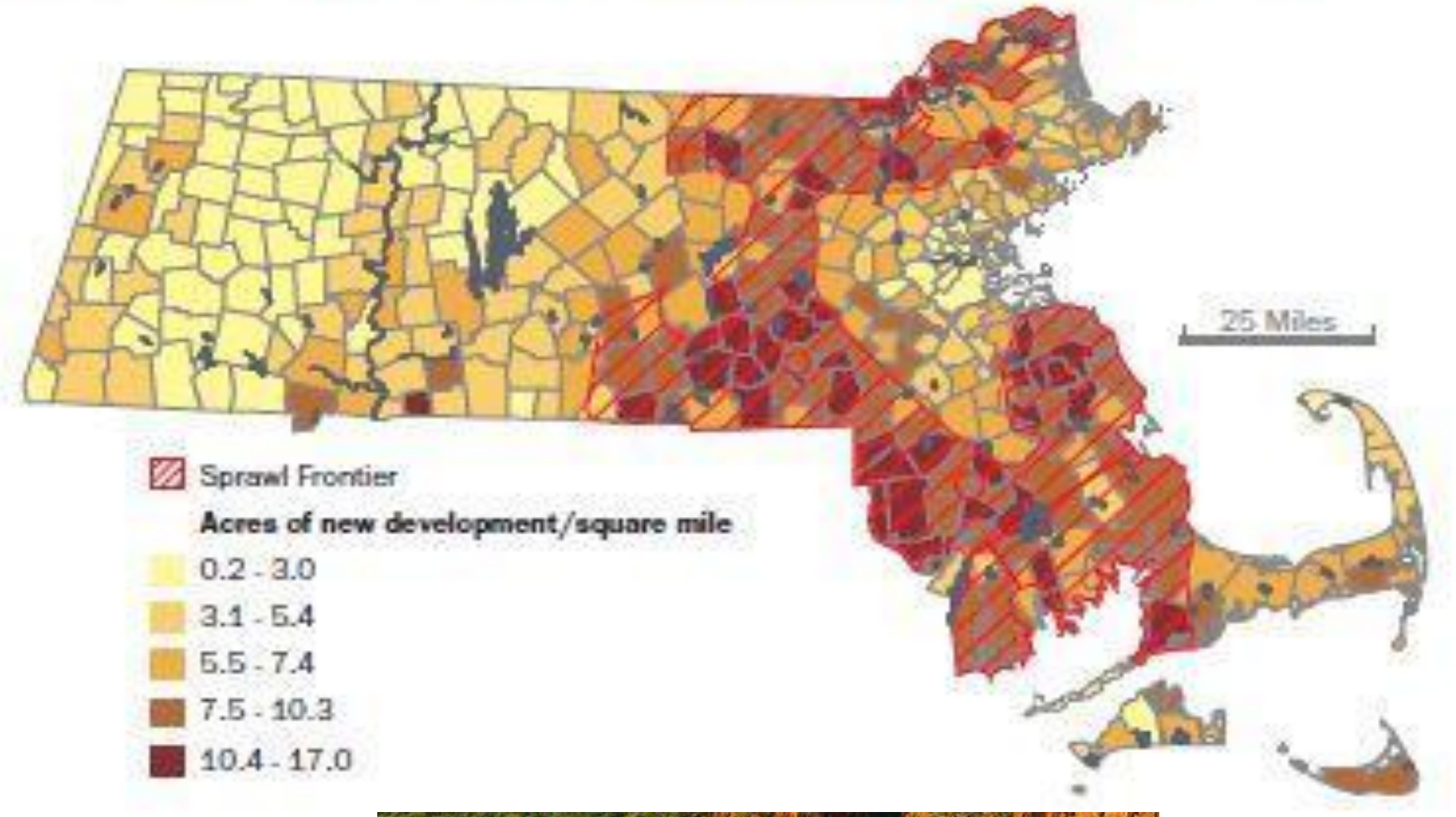
EKC and Land Cover

Seems an EKC should exist for land cover/deforestation

- Slight EKC for deforestation (Koop and Tole 1999)
- Forest Transition (Mather 1992)
- Northeastern US from agriculture to industrial to service (Drummond and Loveland 2010)

However: Northeastern US has lost 3.7% forest cover since 1973 (Drummond and Loveland 2010)

Figure 1.2: Recent development trends in Massachusetts (1999-2005)



Source: DeNormandie et al. (2009)

CONVERSION OF 22 ACRES PER DAY FROM A NATURAL TO A DEVELOPED STATE IS LIKE CREATING A DEVELOPMENT THE SIZE OF THE CITIES OF NEW BEDFORD, LAWRENCE, AND SPRINGFIELD COMBINED EVERY 5 YEARS.

Pilot Study Results/Method

- Focus on Massachusetts
- Calculate how economic output per county has changed over time and whether an EKC exists

So, **does intensity of land use peak and decrease,and does land transition back to low intensity use/cover type (forest) as economic output increases?**

Available Data-Land Cover

- Land Use Layers from MassGIS
  - 1971 1985, 1999, 2005
  - Split in 21 classes
  - Can be summarized into 'less developed' and 'more developed'
- Or, Landsat data, classified into 'more developed' and 'less developed' classes (or, possibly 5 (lacks spatial resoultion though)
  - Urban, Residential, Water, Forest, Agriculture/Open
  - Potentially classify non-Landsat, though harder to do

Available Data-Economic

US Census Economic Data

- Economic Output per industry per county
  - Specifically "Sales, Receipts and Value of Shipments"

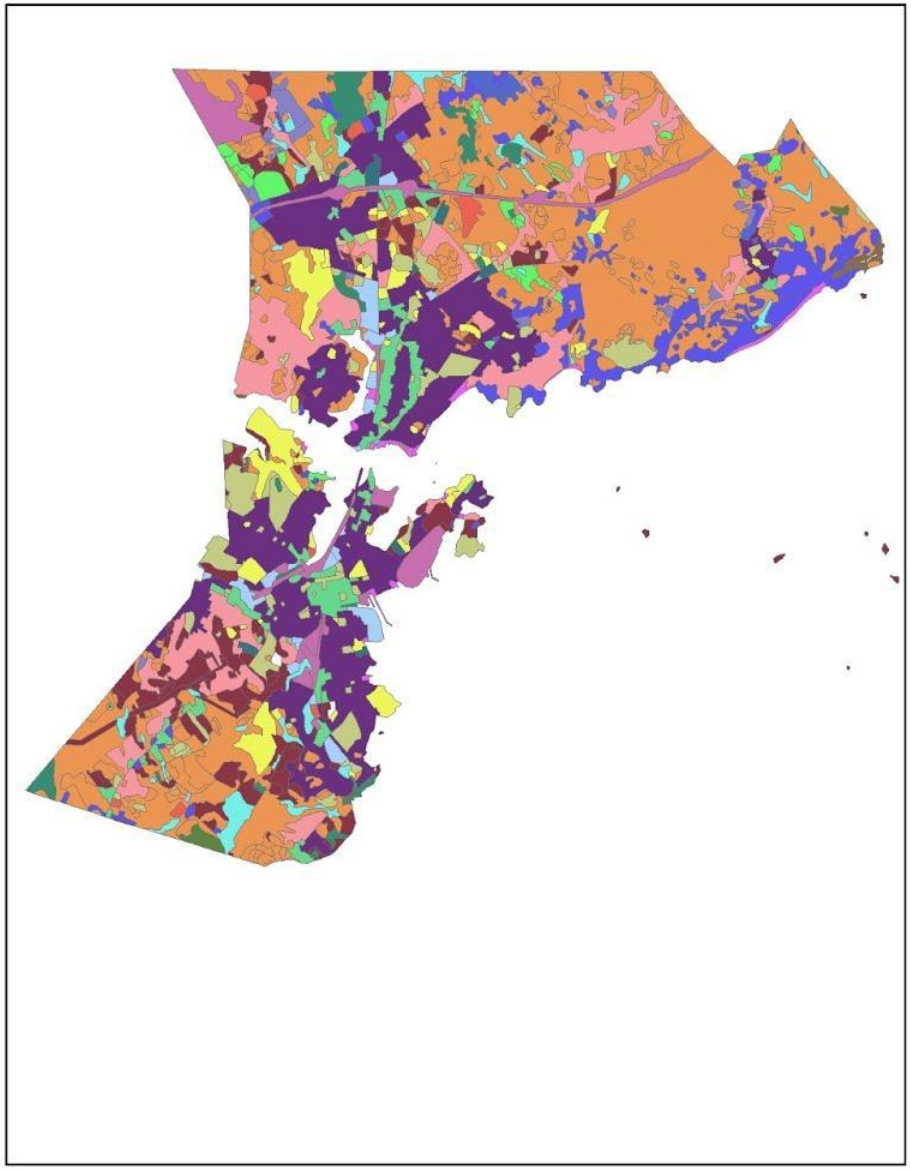
Digitally available for

- 1977, 1982, 1987, 1992, 1997, 2002, 2007, 2010

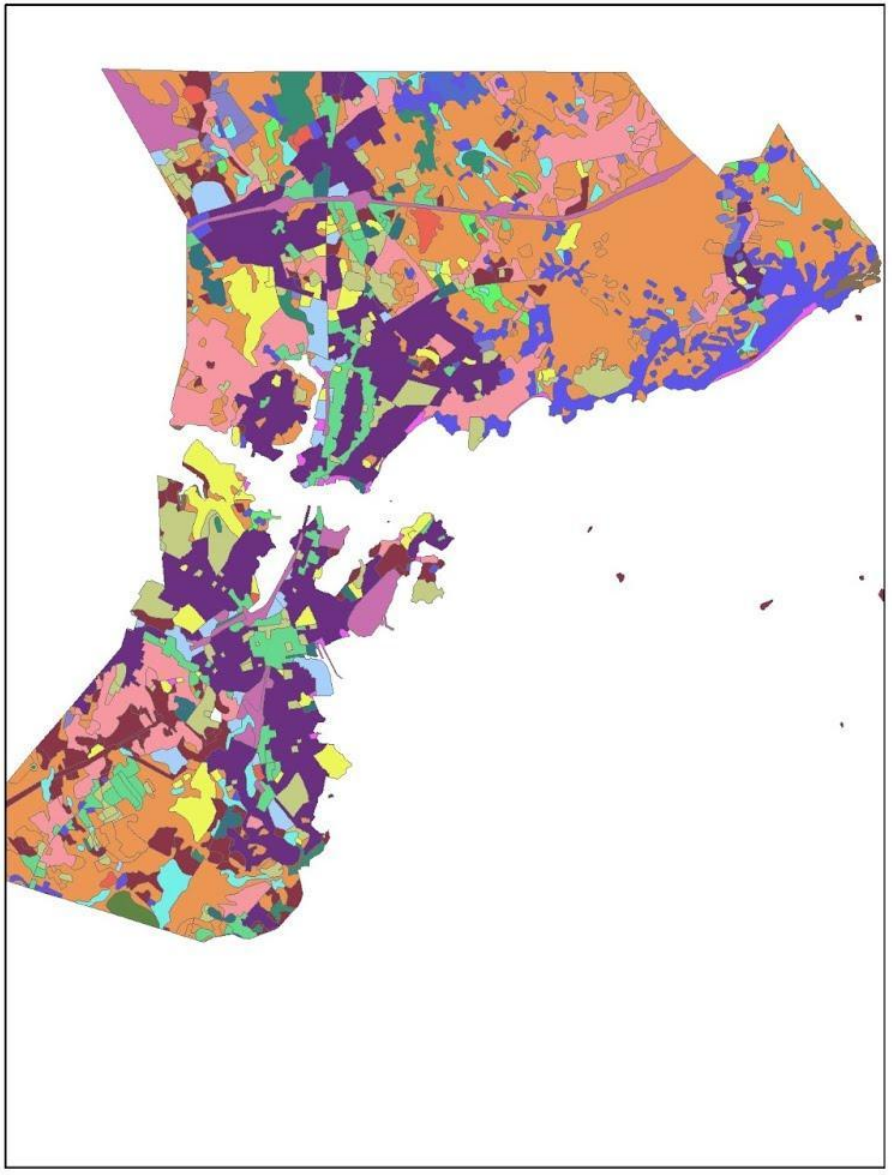
Tax records per county were not easily accessible, plus

Land Use In Beverly and Salem, 1971 and 1985

1985



1971



Method, continued

- Classified land: number of acres of each classification type counted and summed per county, per year of analysis
- Total sales, receipts and shipments summed for each town and then joined and aggregated to the county level.
- Adjusted for inflation via the consumer price index

Data Analysis

- Graph percent change of number of acres from 'developed' to 'undeveloped' versus the adjusted-for-inflation total sales, receipts and shipments
- Regression with the sales and receipts as I.V. and percent change of each cover type for each set of time periods as D.V.

Further Analysis

- Change matrix: each cell tested for a change from a 'less developed' to 'more developed' state, and vice versa.
- Number of acres from more developed to less developed per classification per county . a progression from wilderness to agriculture to residential to urban
- Acres moved ‘up’ scale of development vs. ‘down’ scale of development

Conclusion

- Looking for a trend of inverted-U
- Perhaps we are on the downward slope?
- Maybe an EKC doesn’t exist?
- Can also consider extensiveness or land use, instead of just intensiveness

We’ll have to see…

Questions?

Such as, why was that presentation so awesome/long?

Or

Can I have your autograph?

Works Cited

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