Policy Instruments and Experimental Economics

Brian Scott - Visiting Scientist funded by the ARC Economic Design Network and the SIRCA Experimental Economics Laboratory (SEElab), CSIRO, Department of Finance, Economics, and Quantitative Methods, University of Alabama at Birmingham

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Policy Instruments

- Nitrogen removal from the Illinois waterways system
  - 3 potential regulations
- VOC emissions control
  - 2 (4) potential regulations

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Background – Nitrogen Removal

- Illinois River Watershed has high levels of nitrogen and phosphorous
  - Point and non-point sources
- High levels of N and P lead to hypoxia
  - Dumps into the Gulf of Mexico
    - Dead Spot
- USEPA becoming more active in the reduction of N and P in US waterways
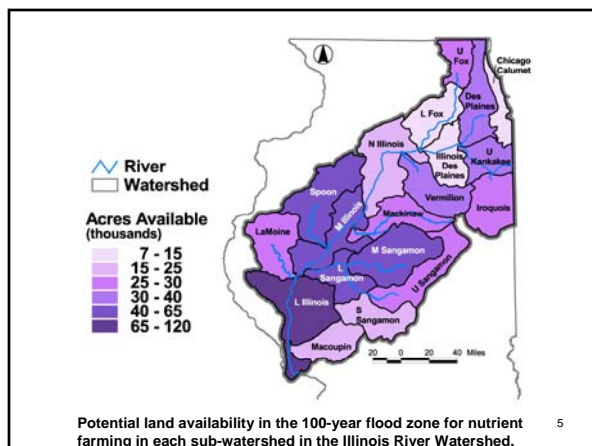
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Background II

- The Wetlands Initiative (TWI) spearheaded nutrient farming in the Illinois River Watershed
  - Beta test a managed wetland
  - Needed a way to pay for wetland creation
  - Focused on Market Based Solutions
- This is a real life application of a market

  http://www.wetlands-initiative.org/

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Potential land availability in the 100-year flood zone for nutrient farming in each sub-watershed in the Illinois River Watershed.

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Market Attributes I

- Point source emitters for this program (Buyers)
- Managed wetlands (Sellers)
- Polluters need not reduce emissions
  - Credits are produced not created
- Non-temporal program
  - Seasonal
    - No banking or borrowing
- Emissions and land prices higher in North

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Market Attributes II

- Total Emissions
  - Ei is an emitter
  - Eij is the amount of emissions from emitter Ei absorbed by wetland j

$$\sum_{j=1}^{m} E_{ij} = \bar{E}_i \quad i = 1,\ldots,n$$

Market Attributes III

- Wetland region (subset)
- Nj is the nitrogen removal capacity for one region – based on land and water flow
- B is a charge/penalty on permits (not price) discussed later
  - Assume it is 1

$$\sum_{i=1}^{n} \beta_{ij} E_{ij} \leq N_j \quad j = 1,\ldots,m$$

Market Attributes IV

- Objective function
  - cij is the marginal cost to the wetland region j of removing emitter i's emissions
  - Varies on land price and season (productive capacity)

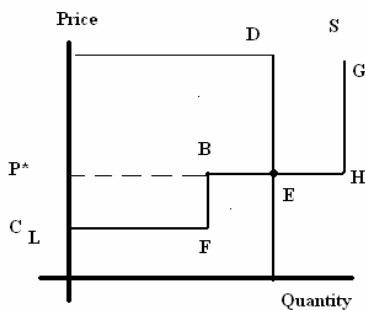$$\min \sum_{i=1}^{n} \sum_{j=1}^{m} \beta_{ij} c_{ij} E_{ij}$$

Market Attributes V

- All emissions must be absorbed
- Wetland regions can't oversell
- Emitters can't have emission "sinks"

$$\sum_{j=1}^{m} E_{ij} = \bar{E}_i \quad i = 1,\ldots,n$$

$$\sum_{i=1}^{n} \beta_{ij} E_{ij} \leq N_j \quad j = 1,\ldots,m$$

$$E_{ij} \geq 0 \quad j = 1,\ldots,m, \quad i = 1,\ldots,n$$

Supply and Demand

Spatial Distribution

- Emissions are spatial (travel from N to S)
  - Distance traveled effects damage
- Damage is increased the further emissions travel
- Incentive to keep emissions removal close to emission point
- Emissions highest in North
- Land values highest in North

Treatments/Market Rules

- Unregulated
- Charge (Bij)
  - Permits charged for buying offsets from wetlands outside your "backyard", bubbles

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Assumptions

- Marginal cost of traditional method constant
- Marginal cost of wetland production constant
  - Cost variation found in
    - land prices
    - seasons
- Marginal cost of wetland production equal to average cost
- Land values do not change with creation of wetlands
- Two agents in each wetland region (one buyer, one seller)
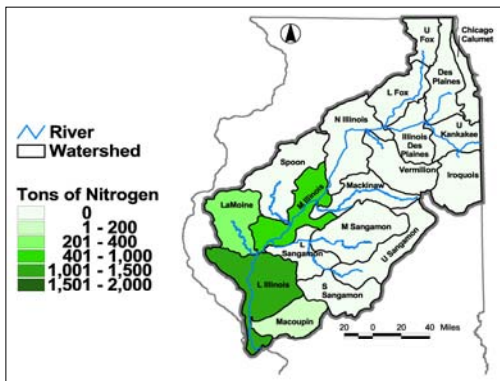- Damages are sufficient to support program
  - Refinement?

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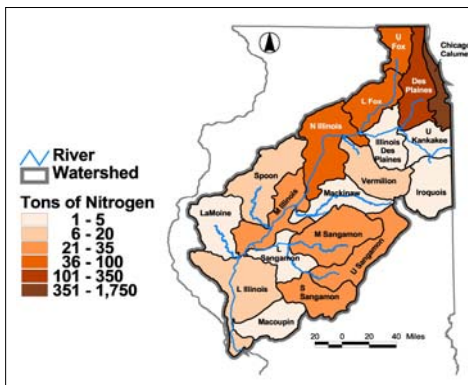
The nitrogen credit demand for each sub-watershed in the Illinois River Watershed. 15
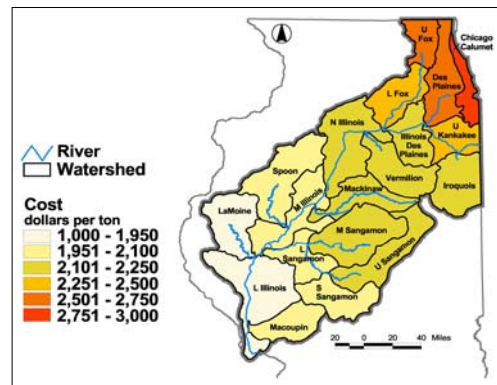
The marginal cost of removing one ton of nitrogen for each sub-watershed in the Illinois River Watershed. 16

Credits traded in the spring months under the "unrestricted scenario" for each sub-watershed in the Illinois River Watershed. 17

Results

- Treatments
  - Unrestricted < Charge
- Wetland creation has the tendency to be in the South
  - Lower land values
- We don't have 36 participants

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Experimental Questions

- What are the effects of the different treatments?
  - Distribution of wetland creation
  - Effect on abatement costs
  - Effect on wealth redistribution
  - Competitive with traditional methods?

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Experimental Questions II

- What is the tendency of the price?
  - Closer to the…
    - chemical method
    - Marginal Cost of Wetland
  - Implications for profit, viability, and adoption
  - Other Questions
  - Anomalies
- We can implement any kind of market relatively cheaply

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Future Research

- Combinatorial Auction?
- Phosphorous
- Both N and P
- Intertemporal (trading over seasons)

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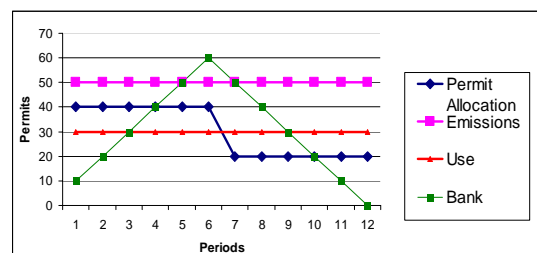## Effects of Banking Regulations on Emission Permit Markets

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Background

- US EPA mandates VOC reductions
- Illinois EPA creates ERMS (Emission Reduction Market System)
  - Permit scheme
  - One Year Banking provision
    - Is the One Year Banking provision a good idea
    - Why do this

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Predictions, Unlimited
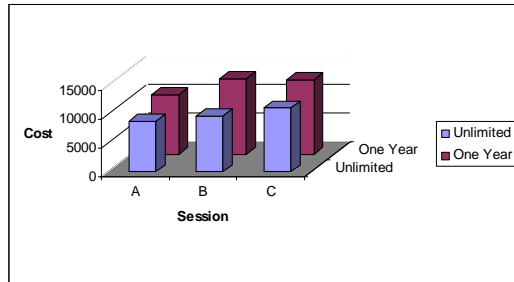

Note: values are aggregated for all firms

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Banking Treatments

- Unlimited Banking
  - No limits on trading
  - No limits on banking
- One Year Banking
  - No limits on trading
  - Permits can not be banked for more than one year
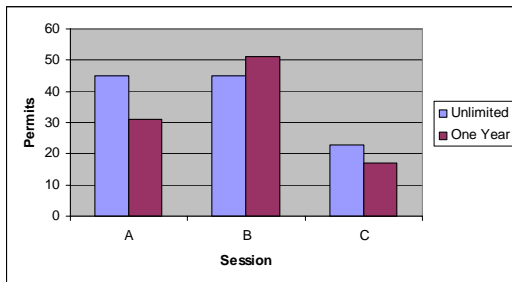   - If they are, the permits expire

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Abatement Cost Comparisons
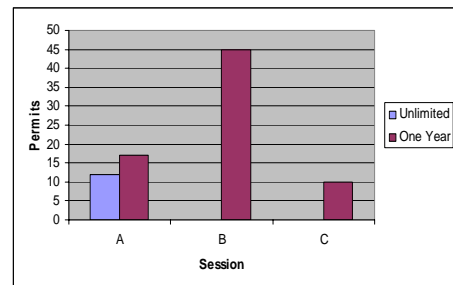

Note: values are aggregated for all firms

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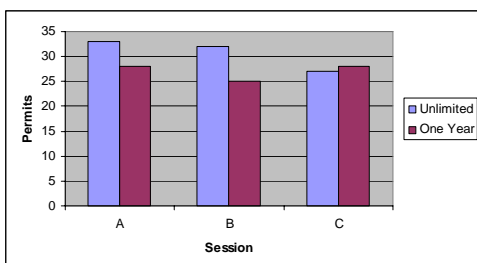## Aggregate Bank In Period 6

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Expired Permits

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Permits Used in Periods 7-12 (Hot Spots)

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Conclusions

- Aggregate Abatement Costs are consistently higher under the One Year Banking Rule
- Emissions (Hot Spots) were, in general, higher under the Unlimited Banking Rule

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Other Treatments

- Limited Use
  - Chicago ERMS market
- NOx Progressive Flow Control

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