Individual Decision-Making and the Valuation of Varying Shoreline Protection Measures in Mobile Bay, Alabama

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Purpose:

- Examine individuals’ decision-making process regarding shoreline protection measures in Mobile Bay, Alabama
- Model individuals’ probability of armoring their shoreline using revealed and stated preference (i.e. contingent behavior) data
- Random effects probit model, which controls for unobserved heterogeneity at the individual level
Mobile Bay, Alabama

- The National Estuary Program has deemed Mobile Bay an estuary of national significance due to its economic and environmental importance.
- 92% of its shorelines are experiencing erosion (Jones et al., 2009).
- Over 50% of the bay's total coastline is armored (Living Shoreline Summit Steering Committee, 2006).

Douglass and Pickel 1999
Options for Protecting Shoreline Property Against Erosion

1. **Do nothing** - Leave the shoreline unaltered

2. **Armor** – (most popular)
   - Rip-rap revetment
   - Vertical wall
   - Vertical wall supplemented with rip-rap

3. **Natural Protection** - gaining popularity, but limited applications
Background:

- Studies of shoreline protection decisions have been broad in scope:
  - Examine costs and benefits associated with the decision to either abandon or preserve an entire shoreline
  - Focus on decision-making process of various stakeholders and institutions
- Studies valuing specific erosion management strategies in the U.S. are concerned with the country’s expansive protective barrier islands and vast amounts of beaches
- Much less attention on shoreline management decisions at the individual level
Data:

- Collected by Steven Scyphers (working with University of South Alabama) in 2011
- Previously used to investigate coastal resilience and to develop a framework for improved communication and decision making in Mobile Bay, Alabama
- Survey instrument has five major themes:
  1. Perceptions residents hold towards the threats and the overall health of Mobile Bay,
  2. Alabama fisheries and their habitats,
  3. Coastal management,
  4. Individual property characteristics,
  5. And demographic information

**Shoreline Types**

- 55% Vertical Wall
- 19% Vertical Wall with Rip-Rap
- 19% Rip-Rap
- 7% Natural/Vegetated
Data:

• 357 observations

• Variables of interest for this study:
  – anything that could possibly influence the propensity of shoreline armoring
  – perceived costs and benefits associated with alternative shoreline options

• Variables used/created for this study include:
  – maintenance costs (per foot) for each of the four shoreline types
  – dummy variables for varying levels of income and education
  – revealed preferences for whether or not an armored or natural shoreline is preferred over the present method
## Descriptive Stats:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armor</td>
<td>0.81</td>
<td>0.39</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NeighborShoreline</td>
<td>0.83</td>
<td>0.37</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Primary Residence</td>
<td>0.74</td>
<td>0.43</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Years on Bay</td>
<td>26.21</td>
<td>18.69</td>
<td>1</td>
<td>76</td>
</tr>
<tr>
<td>Number in Household</td>
<td>2.52</td>
<td>2.13</td>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>College</td>
<td>0.42</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Shoreline Length</td>
<td>100.42</td>
<td>64.8</td>
<td>45</td>
<td>900</td>
</tr>
<tr>
<td>Hard Effective*</td>
<td>0.87</td>
<td>0.34</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hard Appealing*</td>
<td>0.86</td>
<td>0.35</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hard Damaging*</td>
<td>0.75</td>
<td>0.43</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

* = perception variables
Average Costs Associated with each Shoreline Type:

<table>
<thead>
<tr>
<th>Shoreline Type</th>
<th>Initial Cost</th>
<th>Maintainance Costs (per year)</th>
<th>Maintenance Days (per year)</th>
<th>Initial MaintCosts/Foot</th>
<th>Shoreline Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoreline 1: Vertical Wall</td>
<td>76,570.40</td>
<td>873.09</td>
<td>11.46</td>
<td>829.11</td>
<td>9.04</td>
</tr>
<tr>
<td>Shoreline 2: V.W. with Rip-rap</td>
<td>33,675.68</td>
<td>856.54</td>
<td>9.65</td>
<td>370.72</td>
<td>11.07</td>
</tr>
<tr>
<td>Shoreline 3: Rip-Rap</td>
<td>20,536.20</td>
<td>1,066.67</td>
<td>10.41</td>
<td>175.55</td>
<td>6.12</td>
</tr>
<tr>
<td>Shoreline 4: Natural</td>
<td>0.00</td>
<td>422.83</td>
<td>13.48</td>
<td>0.00</td>
<td>3.46</td>
</tr>
</tbody>
</table>
Methods:

• Random effects probit regression model
  – controls for unobserved heterogeneity at the individual level

• Armored = bulkheads, rip-rap revetments, breakwater/wave attenuating device, and groins

• Unaltered = vegetated shorelines and shorelines with no erosional control
## Results:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neighbor’s Shoreline</td>
<td>2.332</td>
<td>0.506</td>
<td>***0.000</td>
</tr>
<tr>
<td>Neighbor’s Influence</td>
<td>0.777</td>
<td>0.355</td>
<td>**0.029</td>
</tr>
<tr>
<td>Years on Bay</td>
<td>-0.019</td>
<td>0.008</td>
<td>**0.019</td>
</tr>
<tr>
<td>Hard Effective</td>
<td>0.863</td>
<td>0.444</td>
<td>**0.050</td>
</tr>
<tr>
<td>Hard Appealing</td>
<td>0.802</td>
<td>0.444</td>
<td>*0.071</td>
</tr>
<tr>
<td>Age</td>
<td>0.033</td>
<td>0.015</td>
<td>**0.030</td>
</tr>
<tr>
<td>Hard Env. Damaging</td>
<td>-0.557</td>
<td>0.411</td>
<td>0.176</td>
</tr>
<tr>
<td>Hard Maintenance</td>
<td>0.112</td>
<td>0.365</td>
<td>0.760</td>
</tr>
<tr>
<td>Shoreline Length (logged)</td>
<td>-0.284</td>
<td>0.326</td>
<td>0.384</td>
</tr>
<tr>
<td>Income (logged)</td>
<td>0.152</td>
<td>0.240</td>
<td>0.526</td>
</tr>
<tr>
<td>College</td>
<td>-0.418</td>
<td>0.370</td>
<td>0.259</td>
</tr>
</tbody>
</table>

N=357
Log likelihood= -149.06
Discussion:

• The Alabama Natural Resources Defense Council’s (NRDC) annual report (2011) stresses the need for a formal state-wide plan addressing shoreline protection under continued sea level rise and climate change.

• Frameworks for coastal decision making are ultimately shaped by the norms and values of a particular society and perceptions of risk (Adger et al. 2005; Berke and Smith, 2012; Zobel, 2011; Van Der Leeuw, 2000).

• Shoreline protection decisions should include all stakeholders to develop integrative strategies meeting the social objectives of the community.

• Need more data on costs!
  – Allows for a more detailed analyses of each shoreline type rather than simply “armored” or “natural”
Questions, Comments, or Suggestions???