Residential location and changing water amenity values: Evidence from the Great Lakes
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Abstract
Cleaning up surface water pollution has the potential to yield significant economic benefit for nearby communities. We hypothesize that water quality improvements following federal legislation in the 1970s have been economically beneficial to coastal communities in the Great Lakes region. To measure these benefits, we use counts as locations and model residential mobility by county in Michigan since the 1970s, using a two-step sorting model incorporating demographic data from 1970 to 2000. We use the model to identify the desirability of counties in each decade of the state. We then use regression analysis to estimate how much the value of living in counties adjacent to the lakes has changed over time. The regression results indicate how values can change over time, which could be driven by changes in water quality as well as economic changes. We find evidence that living near Lake Michigan but not the other Great Lakes has increased since the 1970s.

Hypothesis
We hypothesize that the benefit of living near each of the Great Lakes has increased since 1970, consistent with improvements in water quality across the basin.

Methods
We test this hypothesis using a two-part sorting model. First, we adopt the modeling framework developed by Depro et al. (2015) to simulate moving patterns from location $j$ to location $k$. Household $i$ receives utility from living in location $j$ at time $t$ denoted by $U_{ijt}$. To estimate these utilities, we write out the utility function as:

$$U_{ijt} = \delta_{jt} + \eta_{jt}$$

where $\delta_{jt}$ represents the mean utility of living in community $j$ to household $i$ in time period $t$, and $\eta_{jt}$ is the error associated with household $i$.

Move share estimation
The share of population that moves from community $j$ to $k$ between the two periods $t$ and $t+1$ is estimated by the following equation:

$$S_{jkt+1} = e^{\delta_{jt} - \delta_{kt} - \mu_{MC_{jkt}}}$$

Where $N$ is the number of location alternatives, including 83 Michigan counties and 1 alternative location representing moves to or from outside of the state. We then use Excel Solver nonlinear optimization to solve for $\delta_{jt}$ and $\mu$ parameters to generate predicted move shares that match predicted county populations with the actual county populations at the end of each decade.

Regression analysis
We then use estimates of the mean utilities $\delta_{jt}$ from the sorting model calculations as measures of the value of living in each county. These estimates can be interpreted as measures of conditional quality of life in different residential locations (counties). We can measure the contribution of county attributes to these values using a regression of the estimated mean utilities on county attributes. Average utility is decomposed into the following regression equation:

$$\delta_{jt} = \gamma_{j} + \beta X_{jt} + \theta t + \phi_{j} + \varepsilon_{jt}$$

Where $\gamma_{j}$ represents a vector of lake-specific dummy variables, $t$ is an indicator equal to one for each time period, $X_{jt}$ includes location characteristics specific to each decade, $\phi_{j}$ accounts for a community fixed effect, and $\varepsilon_{jt}$ represents error. We explore several different location-specific variables, which are presented in Table 1. County-level data is drawn primarily from the U.S. Census Bureau, over the years 1970, 1980, 1990, and 2000. The coefficients for each lake in the regression output represent the relative desirability of living near each lake.

Results
The regression estimates provide evidence that the value of living near Lake Michigan has increased since the 1970s. The estimates indicate that households are willing to pay about $150 more per year to live in a Lake Michigan county in 2000 than in 1970 (all values are adjusted for inflation). There is no significant evidence that the value of living near Lake Erie of Lake Huron has changed since 1970. The results also indicate that the value of living near Lake Superior has declined since 1970, which could be due to reductions in mineral extraction in the Upper Peninsula of Michigan, leading to fewer jobs in the surrounding communities.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>St. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita personal income</td>
<td>-0.0074*</td>
<td>0.0039</td>
</tr>
<tr>
<td>Average monthly temperature</td>
<td>-330.28</td>
<td>324.55</td>
</tr>
<tr>
<td>Average monthly temperature squared</td>
<td>5.44</td>
<td>4.11</td>
</tr>
<tr>
<td>Population density</td>
<td>2.10**</td>
<td>0.91</td>
</tr>
<tr>
<td>Population density squared</td>
<td>-0.00031**</td>
<td>0.00014</td>
</tr>
<tr>
<td>Percent Black residents</td>
<td>-289.17</td>
<td>1022.9</td>
</tr>
</tbody>
</table>

Table 1. Additional parameter estimates from the mean utility regression.
Note: **, * indicate statistically different from zero at 5%, 10% levels.

The regression also provides evidence that county-level per capita income and county population density have a significant effect on the value of living in a county. There is no evidence that temperature or racial composition affects values at the county level.

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