Discrete Choice Modeling of Fishermen’s Landing Locations

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Quotas: Efficiency & Equity Goals

• Economic efficiency
  – In place of “race to fish,” fishermen can target and sell catch when/where value is highest

• Non-efficiency goals imposed on quota policies
  – E.g., processor quota, CDQs, quota transfer restrictions

• More community-focused measures likely
Research Questions & Motivation

How will geographically targeted, equity-focused policies affect fishermen, seafood processing, and fishing communities?

*Do fishermen make profit-maximizing decisions that are responsive to changing economic opportunities across space?*
Fishing Location Choice Literature

• Many discrete choice models include expected revenue across locations/time and travel distance [Eales and Wilen 1986; Smith 2002; Haynie, Hicks, and Schnier 2008; Haynie and Layton 2010; Zhang and Smith 2011]

• Some incorporate past behavior (state dependence) and/or unobserved heterogeneity (random coefficients) [Holland and Sutinen 1999; Mistiaen and Strand 2000; Smith 2005]

...But do findings translate to landing location choices?
Discrete Choice Model of Landing Locations

Port A
Exp. Revenue = $3k
Distance = 80 km

Port B
Exp. Revenue = $2k
Distance = 40 km

Port C
Exp. Revenue = $1k
Distance = 20 km

Port D
Exp. Revenue = $2k
Distance = 60 km
Discrete Choice Model of Landing Locations

- RUM framework
- Choice probabilities:
  \[ P_{ni} = \frac{e^{\beta'x_{ni}}}{\sum_j e^{\beta'x_{nj}}} \]
- Maximum Likelihood Estimation

- **Conditional Logit Model 1:**
  \[ U_{nj} = \beta_j + \beta_{ER} EXP \ REV_j + \beta_{DIST} DISTANCE_{nj} + \varepsilon_{nj} \]

- **Conditional Logit Model 2:**
  \[ U_{njt} = \beta_j + \beta_{ER} EXP \ REV_{jt} + \beta_{DIST} DISTANCE_{njt} + \beta_{SD} CHOICE_{n,t-1} + \varepsilon_{njt} \]
Empirical Application: Finnmark, Norway

- Daily microdata for groundfish fishermen
- ~500 vessels, 14 ports
- Single year (2010)
- Distances from chosen fishing spot to every port
- Expected revenues by port
- Multiple trips per vessel
## Empirical Results: All Vessels

<table>
<thead>
<tr>
<th></th>
<th>Model 1(a)</th>
<th>Model 1(b)</th>
<th>Model 1(c)</th>
<th>Model 2(a)</th>
<th>Model 2(b)</th>
<th>Model 2(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving Avg. Revenue, Past 30 Days ($1000s)</td>
<td>0.0014***</td>
<td></td>
<td></td>
<td>-0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving Avg. Revenue, Past 45 Days ($1000s)</td>
<td></td>
<td>0.0014***</td>
<td></td>
<td></td>
<td>-0.0005</td>
<td></td>
</tr>
<tr>
<td>Moving Avg. Revenue, Past 60 Days ($1000s)</td>
<td></td>
<td></td>
<td>0.0018***</td>
<td></td>
<td></td>
<td>0.0003</td>
</tr>
<tr>
<td>Distance Between Fishing Area and Community (in miles)</td>
<td>-0.0887***</td>
<td>-0.0888***</td>
<td>-0.0890***</td>
<td>-0.0413***</td>
<td>-0.0408***</td>
<td>-0.0406***</td>
</tr>
<tr>
<td>Landing Community Chosen in Previous Period</td>
<td></td>
<td></td>
<td></td>
<td>5.0572***</td>
<td>5.0735***</td>
<td>5.0799***</td>
</tr>
<tr>
<td>Number of cases</td>
<td>9,347</td>
<td>9,350</td>
<td>9,352</td>
<td>8,882</td>
<td>8,885</td>
<td>8,887</td>
</tr>
</tbody>
</table>

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

*Site-specific constants and standard errors not shown.*
Port-Switchers vs. Non-Port Switchers

• ~75% of vessels *never* change where they land

• How are port-switching vessels different from those that always land in the same port?

<table>
<thead>
<tr>
<th>Measure</th>
<th>Port-Switchers</th>
<th>Non-Port Switchers</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. vessel length (meters)</td>
<td>13.75</td>
<td>12.25</td>
<td>2.04</td>
<td>0.0428</td>
</tr>
<tr>
<td>Avg. travel distance (miles)</td>
<td>32.3</td>
<td>22.8</td>
<td>2.67</td>
<td>0.0085</td>
</tr>
<tr>
<td>Avg. # of fishing spots visited</td>
<td>2.7</td>
<td>1.6</td>
<td>6.90</td>
<td>0.0000</td>
</tr>
<tr>
<td>% of fishing trips in top-ranked fishing spot (by weight)</td>
<td>76%</td>
<td>92%</td>
<td>-8.23</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

• ER still non-significant for port-switcher subgroup
Empirical Results: Random Coefficients

### Model 2(c)

<table>
<thead>
<tr>
<th>Mean $\beta$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving Avg. Revenue, Past 60 Days ($1000s)</td>
<td>0.0010***</td>
</tr>
<tr>
<td>Distance Between Fishing Area and Community (in miles)</td>
<td>-0.0410***</td>
</tr>
<tr>
<td>Landing Community Chosen in Previous Period</td>
<td>5.6025***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Deviation of $\beta$</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moving Avg. Revenue, Past 60 Days ($1000s)</td>
<td>0.0014+</td>
</tr>
<tr>
<td>Distance Between Fishing Area and Community (in miles)</td>
<td>0.0314***</td>
</tr>
</tbody>
</table>

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

*Note: Site-specific constants not included in these models.*
Empirical Results: Random Coefficients

Expected Revenue Coefficient

Frequency

"Arbitrageurs"
Conclusions

• Insights from the fishing location choice literature do not translate perfectly to landing location choices.

• Results are similar when models run naïvely, but when state dependence is accounted for, significance on expected revenue goes away, even for port-switchers.

• Allowing for random parameters shows that portions of the fleet respond to revenues.

• Results imply that restricting landing locations may be much more costly than policymakers realize.
  
  – Compensating variation 37x higher for Model 2 than Model 1
Next Steps: Policy Simulations

• How long does it take for behavior to re-equilibrate following a revenue shock at one landing site?

• If fleet were required to land X% in a particular port, what would the welfare implications be?
Thank you

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Photo: Karim Sahai