Evaluating Changes in Total Factor Productivity in the Amendment 80 Catcher-Processor Fishery

Ben Fissel*, Chris O’Donnell**, Ron Felthoven*, Steve Kasperski*

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* Alaska Fisheries Science Center
  Economics and Social Sciences Research Program
** University of Queensland
The Amendment 80 Story

- The BSAI non-pollock trawl fleet is a multispecies fishery where by-catch historically constrained productivity
  - Limits on catch of prohibited species routinely closed fisheries for target species
  - High discard rates for non-target A80 species

Abbott, Haynie and Reimer (2014), HIDDEN FLEXIBILITY: INSTITUTIONS, INCENTIVES AND THE MARGINS OF SELECTIVITY IN FISHING
The Amendment 80 Story

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  – Limits on catch of prohibited species routinely closed fisheries for target species
  – High discard rates for non-target A80 species

• In 2008 the regulations governing the fleet were restructured:
  – Tiered increase in groundfish retention standards (GRS)
  – Increased flexibility over prohibited species catch (PSC) within cooperative framework
  – Total allowable catch (TAC) allocated as catch shares (rights based system allocating a portion of the catch) and facilitated formation of cooperatives.
What can we learn from the A80 fleet?

Catch shares in a Multispecies Setting

• Rigidities in ex-ante allocation may distort quota markets and impact potential productivity (e.g. Squires et al. 1998; Pascoe et al. 2007; Holland 2013)
  – Difficulty in matching catch composition to the portfolio of quota allocated
  – Over-priced “choke” species and/or under-priced “slack” species

• Quota balancing schemes may mitigate impacts (Sanchirico et al. 2006)

• Incentives to increase selectivity not present in common pool could mitigate distortions. (Abbott et al. 2014)
  – Selectivity may increase input costs
Productivity and Selectivity

• Abbott et al. (2014) find significant changes in A80 fleet PSC selectivity behavior post-rationalization through:
  – Adjustments of fishing grounds
  – Timing of fishing activities

• This research addresses A80 productivity and costs showing:
  – Increases in total factor productivity driven by technical change
    • Consistent with relaxation of output constraints (PSC closures)
  – Increases in output and marginal increase in vessel concentration in target species
    • Catch below TAC for key species indicating fleet may be undercapitalized
  – Little change in aggregate input use
    • Labor increased slightly while fuel use dropped slightly
    • Efficient inputs use post-rationalization offsets any additional selectivity
Decomposing Productivity Indices
O’Donnell (2012)

\[ TFPI_{st} = TI_{st} \times ZI_{st} \times OTEI_{st} \times OSMEI_{st} \times NOISEI_{st} \]

- TFPI: Total factor productivity change
- TI: Technical change
- ZI: Environmental efficiency change
- OTEI: Output technical efficiency change
- OSMEI: Output scale-mix efficiency change
- NOISEI: Random noise
• Post-rationalization total factor productivity (2008) grew by 34%
• Increase in technical change
  – Technical efficiency remained constant

<table>
<thead>
<tr>
<th>Period</th>
<th>Technical Efficiency</th>
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<tr>
<td>2005</td>
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<tr>
<td>2006</td>
<td>0.87</td>
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<tr>
<td>2007</td>
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<td>2008</td>
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<td>2011</td>
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<td>2012</td>
<td>0.87</td>
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• Substantial room for increased production under allowable biological catch (ABC) and total allowable catch
  – Fleet may be capacity constrained
• Low exploitation -> mitigate impact of density dependence in production
  – biological factors contribute little to TFP changes
Species Output Composition

- Herfindahl indices over species production
  - Typical range [0.24,0.33] indicates vessel production is concentrated
  - Little change in composition of species produced by vessels
  - Vessels targeting the same mix of species
• Scale and mix efficiencies decreased slightly
Discard Rates and Production Inputs

Regression of Input Factors and Trends on Discard Rate

|                         | Estimate | Std. Error | t value | Pr(>|t|) |
|-------------------------|----------|------------|---------|----------|
| (Intercept)             | 0.718    | 0.025      | 28.30   | 0.000    |
| log(labor)              | -0.024   | 0.028      | -0.860  | 0.391    |
| log(fuel)               | -0.059   | 0.031      | -1.870  | 0.063    |
| log(food)               | 0.037    | 0.027      | 1.370   | 0.173    |
| log(capital)            | -0.087   | 0.031      | -2.800  | 0.006    |
| Post-rat dum.           | -6.746   | 25.804     | -0.260  | 0.794    |
| time trend              | -0.017   | 0.012      | -1.450  | 0.149    |
| Post-rat trend          | 0.003    | 0.013      | 0.260   | 0.798    |

Adjusted R-squared: 0.641

- Only capital (vessel value) and fuel are significantly associated with changes in groundfish discard rates
  - Vessel with more capital have lower discard rates
  - More fuel is used by vessel with lower discard rates
Concluding Observations

- Pre-catch share mechanism for managing PSC acted as an output constraint.
  - Catch shares + PSC flexibility within a cooperative relaxed the constraint => technical change
- PSC avoidance (selectivity) was achieved
  - Without drastically changing the target species mix
  - Without increases in input use (possibly offset by optimizing input use as a result of rationalization)
- Under coops and catch shares reduced groundfish discards appears to be an optimal decision:
  - Non-binding GRS - Reduced input use - Slack under TAC
- Catch below TAC for key species indicating fleet may be undercapitalized