A Review of Regional Economic Models for Fishery Management in the U.S.

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Objectives

- Provide an overview of regional economic models.
- Review regional economic studies conducted for various fisheries in the U.S.
- Discuss modeling and data issues in relation to use of regional economic models for fishery management.
- Provide guidance on future modeling efforts.

Regional Economic Impact Models

- Fixed-price Models
  - Export-base Model (EB)
  - Input-output Model (IO)
  - Social Accounting Matrix Model (SAM)
  - Supply-determined Models: SDIO and SDSAM
- Flexible-price Model
  - Computable General Equilibrium Model (CGE)
  - Integrated Econometric + Input-output (EC-IO)

Fixed-price Models

- EB Model – Export is the only engine for regional economic growth.
- IO Model – Effects of changes in final demand are calculated using multipliers.
- SAM Model – An extension of IO; measures impacts on income distribution.
- Supply-determined model: Outputs for certain sectors are exogenous. Used to deal with exogenous reduction in productive capacity.

Limitations of Fixed-price Models

- Prices are fixed.
- Demand-driven model with unlimited supply of inputs
- No substitution effects
- Tend to overestimate impacts
- SD models are internally inconsistent because outputs for some sectors are forced to be fixed and final demands for the same sectors are endogenous.

CGE Model

- Supply constraints are explicitly incorporated.
- Substitution effects are allowed.
- Markets attain their equilibrium through adjustment of prices.
- Welfare implications can be examined.
- CGE models overcome limitations of the fixed-price models.
- Most CGE models are static, a few are dynamic.

Review of Impact Studies for Fisheries

- Most studies used IO or IO-based models.
- One SAM model was developed for Alaska fisheries (Seung and Waters 2006).
- One regional CGE model was developed (Houston *et al*. 1997), but this is poorly documented.
- Several integrated regional economic - ecosystem models were developed (e.g., Finnoff and Tschirhart 2003).

IO Studies for Fisheries

- Twenty IO or IO-based studies were reviewed.
- Only one employed a multiregional IO (MRIO, Butcher *et al*. 1981).
- One study used a SDIO (Leung and Pooley 2002).
- Reviewed IO studies deal with commercial fishing (e.g., Herrick and Huppert 1988), sport fishing (e.g., Steinback 1999), or both (e.g., Hushak *et al*. 1986).

Two Major IO Approaches

- NEFSC-type approach directly incorporates the disaggregated fishery-related sectors into the IO framework, and explicitly details the intersectoral relationship (e.g., King and Shellhammer, 1981; NEFSC Model, 2000).

- Fisheries Economic Assessment Model (FEAM)-type approach does not internalize disaggregated fishery sectors within IO framework. Changes in revenues and expenditures are multiplied by IMPLAN multipliers (e.g., FEAM models; Natcher *et al*., 1999).

FEAM

- A major analytical tool for estimating impacts of fishing to regional economies on the West Coast and Alaska
- A production-oriented model to estimate the impacts of supply-side (harvesting sectors) changes
- Because the fishery sectors are specified in a highly disaggregated manner, economic impacts from a change in landings can be calculated by species landed, vessel type, and port of landing.

Comparison of Models for Fisheries

- Fixed-price vs. Flexible-price Models
- Demand-driven vs. Supply-driven Models
- NEFSC-type vs. FEAM-type Models
- Single-region vs. Multi-region Models
- Static vs. Dynamic Models
- Stand-alone vs. Integrated Models

Fixed-price vs. Flexible-price Models

- Limitations of fixed-price models already discussed
- In a CGE model, endogenous prices allow for substitution effects and calculation of welfare change.
- CGE models are more appropriate where policies have significant effects on prices or where productive inputs are limited in supply.
- Developing a CGE has a higher cost than an IO.
  Need to: (a) specify economic agents' behavior
  (b) collect the associated parameters
  (c) calibrate relationships

Length of Run

- In the long run, there are no fixed factors, so the fixed-price model assumption of perfectly elastic supply of productive factors may be appropriate.

- In the very near term (or if the shock is relatively small or the economy is very open), factor supply constraints are not binding, so price response is minimal. A fixed-price model will be appropriate.

- In the intermediate term (especially in a relatively closed or remote regional economy), binding supply constraints retard the response to an economic stimulus. Relative factor prices adjust to reflect this factor scarcity. A flexible price model (CGE) may be most appropriate.

Demand-driven vs. Supply-driven Models

- Fishery management actions typically involve supply constraints (changes in TAC or season/ area closures).
- In this case, demand-driven models may not capture the chain of effects (Leung and Pooley 2002).
- However, if it is known how much final demand for processed seafood will change as a result of change in supply, the impacts of change in the harvesting sector can be effectively estimated using a demand-driven IO.

NEFSC-type vs. FEAM-type Models

- NEFSC-type model captures feedback effects from non-fishery sectors on fishery sectors.
- Requires a large amount of time – Need to modify IMPLAN default data with survey and other data, and specify structural matrices.
- FEAM-type model does not capture feedback from non-fishery sectors. Can underestimate economic impacts. Degree of underestimation may be low since feedback is small, unless fisheries are important suppliers of intermediate inputs to non-fishery sectors.
- Developing a FEAM-type model is somewhat less data and effort intensive.

Single-region vs. Multi-region Models

- Only one interregional model (Butcher *et al*. 1981)
- Single-region models can not estimate spillover effects between regions.
- An interregional approach is more appropriate for Alaska, where most intermediate goods are imported and much factor income leaks out of the region.
- Estimating interregional flows of goods and services is a formidable task.

Static vs. Dynamic Models

- Most studies used static models which collapse adjustment into a single period.
- In the real world, dynamic elements abound. Static equilibrium may incompletely characterize effects over time.
- Treatment of capital accumulation and interregional movement of labor is key to dynamics.

Stand-alone vs. Integrated Models

- Most models are stand-alone, and do not consider the role of the ecosystem.

- In a few recent studies, marine ecosystem model is combined with a regional economic model to capture feedback between the ecosystem and human activities (e.g., Finnoff and Tschirhart 2003, Floros and Failler 2004).

Data Issues

- Published data are either unavailable, unreliable or insufficiently detailed.
- IMPLAN Fishery Data
  - Uses national-average production functions
  - Understates employment in the harvesting sector
  - Too highly aggregated for detailed analysis
- Primary data (employment, earnings, and costs) must be collected via survey. However, reluctance to provide these data makes it very hard to obtain useful regional economic information.
- Other important data issues are (a) how much of intermediate inputs are imported and (b) what is the place of residence of factor owners.

Conclusion

- Choice of a model depends on (a) issues at hand, (b) information needs of decision-makers, (c) time and financial cost of implementing the model, and (d) data availability.
- Regional economic models for analysis of fisheries are relatively few due largely to lack of data.
- One remedy would be to include a mandatory data collection program in reauthorization of the MSA.
- In the absence of accurate economic information, we will continue to fall short of our obligations to maximize economic benefits while minimizing negative impacts on fishing communities.