Overview of Regional Economic Impact Models

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REI Model Description

- A tool for estimating how policy actions will affect an overall regional economy
  - Sales, income, value-added, employment and taxes

Underlying Theory

- Economic Base Model
  - Industries divided into basic (exporting) and non-basic (exist to support basic industries)
    - Basic: manufacturing, agriculture, tourism, etc.
    - Non-basic: Services, retail, governments
  - To strengthen the local economy must develop and enhance basic sectors

$$Base\ Multiplier = \frac{Total\ Employment\ Year\ i}{Basic\ Sector\ Employment\ Year\ i}$$

  - Multiplier provides insight as to how many non-basic jobs are supported by one base job
    - EB model only has two sectors

Location Quotient

- EB Index that compares the concentration of an industry in a local economy to a larger benchmark economy

$$LQ = \frac{e_i / e}{E_i / E}$$

- e_i = local employment in industry i
- e = total local employment
- E_i = benchmark area employment in industry i
- E = total benchmark area employment

EB Projection Techniques

- Constant-Share
  - Assumes local share of an industries activity in a region will remain constant into the future

- Shift-Share
  - Adds a shift factor
    - Based on projected growth rates for a given regional industry relative to the projected growth rates for that industry in the reference economy

Regional Input-Output Models

- Developed by Leontief, 1936 and later adapted to regional economies

$$X = (I - A)^{-1} * Y$$

- X = n x 1 column vector denoting endogenous output
- I = n x n identity matrix
- A = n x n direct input coefficients matrix
- Y = n x 1 column vector denoting exogenous final demand
- $(I - A)^{-1}$ = Leontief Inverse = multipliers

Regional IO Models

- Limitations
  - Constant returns to scale
  - No supply constraints
  - Fixed prices
  - Fixed commodity input structure
  - Static
  - No welfare estimates

SAM IO Models

- Social Accounting Matrix IO models (IMPLAN)
  - Capture transactions between

Households  Governments (state & fed)

Capital  Households

  - Households pay taxes, savings, interest to households (bonds), interest to feds (FHA loans), property taxes, social security, food stamps, health care plans, fishing/hunting fees, etc.

SAM IO Models

- Limitations
  - Same as IO models
  - Household demand is based on average expenditure patterns

Econometric IO models

- Supplement basic IO model with econometric equations
  - Primary demands by econometric equations and intermediate demands are determined by Leontief function
  - REMI model – 53 sector IO model where the econometric and IO portions interactively feed into each other until an equilibrium solution is obtained

Econometric IO Models

- Benefits
  - Improved forecast performance over strictly econometric approaches because more complete account of inter-industry relationships
  - Provides time dimension not present in IO
  - Allows for supply and demand constraints
  - Substitution effects are allowed
- Disadvantages
  - Potential for model misspecification and still relies on fixed input proportions in estimates of production

Computable General Equilibrium Models

- **Computable**: quantitative
- **General**: treatment of all commodities and production factors in the region
- **Equilibrium**: demand and supply of each commodity and factor are balanced through price adjustments

CGE Models

- Production is usually modeled with both non-linear production functions (Cobb-Douglas) and constant elasticity of substitution production functions
  - Level I – model factors (capital and labor) with a non-linear function form
  - Level II – model intermediate inputs with a Leontief fixed-ratio form (SAM from IMPLAN)

CGE Models

- Benefits
  - Prices are allowed to vary, triggering substitution effects in production and consumption
  - In addition to providing distributional effects, welfare implications can be examined

- Disadvantages
  - Number of sectors is much more constrained than in RIO models due to lack of appropriate data on each sector (e.g., elasticities).

	IO	SAM-IO	EC-IO	CGE
Strengths	Captures detailed interindustry linkages Able to implement with IMPLAN	Captures detailed interindustry linkages and distribution of income across institutions Able to implement with IMPLAN	Improved forecasting performance over econometric models Capable of generating time paths of policy impacts	Endogenous prices determine economic response Substitution effects allowed Welfare implications
Weaknesses	No supply constraints No substitution Prices are fixed Static model No welfare effects	Same as I/O	Implementation costs are high Framework for statistical inference is not yet developed Difficulties specifying multiregional models	Implementation costs are high Parameter estimates and elasticities may be hard to obtain or estimate Loss of sectoral detail
Data Requirements	For each industry, data on output, employment, value-added, final demand, imports, make table and use table (IMPLAN provides all)	Same as I/O plus more detailed inter-institutional accounts	Same as I/O plus regional data for econometric estimation	Same as SAM-IO plus estimates of supply, demand and trade elasticities

SAM-IO or CGE for Rec Fishing?

- Contribution Assessments
  - No difference between SAM IO and CGE in terms of estimating regional impacts
  - No counterfactual, no time path

SAM-IO or CGE for Rec Fishing?

- Impact assessments of proposed management actions
  - CGE is theoretically more appropriate, but SAM-IO and CGE may produce similar results
  - CGE entails more realistic assumptions about the production process (price changes ➡ substitution)
  - Differences will be minimal if the proposed actions don't affect prices

SAM-IO or CGE for Rec Fishing?

- For cases where management actions have significant indirect effects on prices or where productive inputs are limited in supply CGE is more appropriate
  - Gulf oil spill
  - For-hire ABC doubles
    - Number of boats and/or effort available is insufficient to harvest all of the fish

Management Questions Addressed by REI Models

- Short-term policy distributional questions
  - Employment, income, value-added, sales and taxes
  - Who, where, how much
- EC-IO and CGE may also provide welfare estimates
- Contribution assessments
  - In total, by type of expenditure, for-hire industry
- Economic development opportunities
  - Building a fishing pier, tradeoffs between maintaining marina space or erecting condos

What Drives Usage of REI Models for Management?

- Statutory requirements
  - MSA, NEPA, EO-12866
    - Explicitly require, to the extent practicable, fishery management actions minimize economic impacts on fishing communities
    - Identify the winners/losers
- Good practice, provides context

How well do REI Models Address Management Needs?

- Still up for debate
- SAM-IO
  - Need to run in conjunction with demand models
    - Currently make assumptions about how effort and participation might change
  - Estimates of associated expenditure changes by region are needed as inputs
  - SAM IO models can be constructed at the county level, but angler expenditure data is state-level
    - Community designations are not county based
- No documented use of CGE or EC-IO models

Examples of Management Use

- Annual specifications for:
  - Summer flounder, black sea bass, scup, bluefish
- Various groundfish actions for Atlantic cod and haddock
- Data required are MRFSS, average angler trip expenditures by state, IMPLAN
- Model results produced quickly with IMPLAN

Recent Advances

- SAM-IO
  - New version of IMPLAN allows for construction of multi-region models
    - Doubly-constrained gravity model to estimate trade flows for 440 commodities between all counties in the U.S.
- EC-IO
  - REMI added mapping capabilities
- CGE
  - Several recent papers by Di Jin, Chang Seung

CGE Advances

- Di Jin links a CGE commercial model to a marine food web model in the Northeast
  - Highly aggregated 5 sector model
- Chang Seung's work mostly concentrated on commercial fishing
  - Recent paper with Dan Lew used a stated preference survey of anglers and angler expenditure data as inputs into a CGE model
    - 18 industries and 17 commodities
    - Elasticities of substitution for 3 household income levels from a study conducted in 1984
    - Find CGE impacts lower than SAM-IO impacts

Obstacle to using REI Models

- SAM-IO
  - Cost: IMPLAN data revised annually
  - Basic underlying knowledge of IO
  - Detailed angler expenditure data by region
  - Time required depends upon specific application
- EC-IO
  - REMI: High learning curve, expensive, revised annually, no marine sectors, no fisheries studies using REMI
- CGE
  - Sectors are highly aggregated, lack of elasticities, high learning curve, high computational cost

ASPECTS of REI Models that Deserve More Attention

- SAM-IO
  - Construction of for-hire sector
    - Cost/earnings data
    - Collecting data in NE, recently collected in Gulf and SE
  - Automation
- CGE
  - Elasticities (production & consumption)
  - Review Alaskan CGE model
  - CGE training workshop?
- EC-IO
  - REMI