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

\[ LQ = \frac{e_i}{e} \]
\[ = \frac{E_i}{E} \]

- \( e_i \) = 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 industry's 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

\[ X = (I - A)^{-1} * Y \]

- \( X = n \times 1 \) column vector denoting endogenous output
- \( I = n \times n \) identity matrix
- \( A = n \times n \) direct input coefficients matrix
- \( Y = n \times 1 \) 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 to Governments (state & fed)

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).
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<th>IO</th>
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| 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