Regional Economic Modeling:
Tools for Economic Development Decisions

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- Ph.D., economics, University of Minnesota, 2008
  - Dissertation: *State Export Behavior and Policy*
  - Advisors: Sam Kortum and Tom Holmes

- Primary research interest in regional development through exportation
  - Informational barriers to trade, costs to begin to export
  - Export promotion policy

- Originally from Delaware

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Regional Economic Modeling

- Methodology & tools yielding data-based predictions for a particular geographic or political area

- Useful for simulating economic activity
  - Outcomes from different policies
  - Outcomes from shocks (good and bad) to region

- Compare counterfactual to real-world data
  - Counterfactual is alternative reality that did not happen (shock or policy)
  - Real-world data (baseline or benchmark) is what actually occurred

- Relatively easy (don’t have to hire consultants) and quick
Types of Questions

- Population projections
- Migration estimates
- Location analysis
- Land use
- Resource management

- Economic impacts (from policy or shocks)
  - Income, revenue, sales
  - Employment
  - Value-added of production

- Economic impact analysis also refers to studies of how important a particular industry is to the income or employment of a region
Tools for Economic Impact Analysis

► Input-Output Analysis
  • Simpler
  • Models interconnectedness of sectors and market transactions
  • (Can be) Useful if geographic issues are important
  • No price changes

► Computable General Equilibrium (CGE, AGE) Modeling
  • More complicated
  • Models interconnectedness of sectors, institutions, factors, and nonmarket transactions
  • Explicitly accounts for price changes
  • (May have) Difficulty with spatial issues

► Both methods are based on the measuring the flow of expenditures around the economy
Not Optimizing Tools

- Gives predictions but not recommendations
  - Tells you overall impact of a shock (good or bad)
  - Does not say how resources should be managed

- Policy makers must decide what to do based on various predictions among other political factors

- Different from Cost-Benefit Analysis (CBA)
  - Impact analysis avoids need for survey to determine costs or benefits
  - CBA is more useful to measure outcomes over long periods of time

- Building a new road vs. subsidizing new factory
Multipliers

- Economic Impact measures how a change in income or employment in one sector flows around to all other sectors.
- Compare ratio of income from a counterfactual (policy or shock) to actual data.
  - Direct: affect on immediate sector or industry.
  - Indirect: affect on upstream or downstream sectors from direct sector.
  - Induced: affect on secondary sectors.
- Net economic impact CAN be expressed as a multiple:
  - Direct + Indirect + Induced = x
  - For each $1 (or 1%) change in direct sector, the total economic impact to region is $x (or x%).
Steps to Policy Analysis

- Choose geographic scope
  What is your region?

- Choose time frame
  Impacts from now on or just for one year?

- Choose model type
  Input-output or CGE?

- Choose data source and modeling software

- Choose counterfactual
  What is the shock or policy to be compared against data?

- Can be done before event (ex ante)
  or after the event (ex poste)
Geographic Scope

- Supra-national
- National
- State
- County
- ZIP code

- Choose BOTH model & data appropriately

- Few pre-built models or standard data below county level
- Multi-state & multi-county models possible
  Must be customized at high time cost
Time Frame & Model Type

- One year counterfactual compared to real world data
  Use input-output or CGE

- Present value of outcomes extending into future
  Use cost-benefit analysis

- Model Type
  - Input-Output
  - CGE
Data Source

  - Collected from national agencies: BLS, BEA, Census
  - 440 sectors (as of 2007)
  - Specialized by region
    * $1840 for WA and all counties
    * $565 per county
  - Software free or cheap with data purchase

- IMPLAN data and software all that is needed for input-output analysis

- Expensive and time intensive to collect own data or for different geographic unit (city)

- Extra data for CGE models also in IMPLAN data
  Data on interactions between institutions and factors
CGE Model Construction

▶ Models use standard economic theory
  • Consumers max utility given income and prices
  • Firm max profit given technology and prices

▶ Professionals build generic CGE models
  • Updated annually
  • EXTREMELY time and resource consuming to build from scratch

▶ Take these off the shelf and trust they are correct
▶ Customize generic model to meet particular study of interest

▶ Note: Exports can be outside of region, outside of U.S., or both
Washington State CGE Model

- Constructed by David Holland (WSU), Leroy Stodick (UI), and Steven Devadoss (UI)
  http://www.agribusiness-mgmt.wsu.edu/Holland_model/index.htm
- Very flexible and general
- Available for free
- Written in GAMS programming language
  http://www.gams.com
  - GAMS files available for free download
  - GAMS compiler and solver (PATH) cost $640 academic
  - Customize WA model to region or industry using GAMS
Social Accounting Matrix & Counterfactual

- Use IMPLAN data and software with CGE GAMS code to produce a Social Accounting Matrix (SAM)
- GAMS code translate IMPLAN files into a SAM suitable for CGE model
  - GAMS code then parameterizes CGE model based on SAM
  - Benchmark

- Choose counterfactual
  - Policy or shock that is manually entered into one (or more) sectors
  - Use one year: what economy would have looked liked in that year if policy or shock occurred
    * All other variables fixed
    * Capital is assumed fixed, labor flexible
Procedure to Create CGE Models from IMPLAN Data

Run IMPLAN to generate 26 CGE files – text files.

Run GAMS program to map CGE files from IMPLAN into a commodity by industry SAM.

Run GAMS program to parameterize CGE model Regional or National.

Run GAMS program to “solve” CGE model for baseline and counter-factual.
Example: Holland et al. 2004

- **Shock:** Mad cow disease (BSE) in WA Dec 23, 2003
  - Japan, Korea, Mexico, Canada ban or limit beef imports: exports down 90%
  - U.S. Demand remains constant

- **Ex poste counterfactual:**
  In 2004, what would beef industry and state be like if BSE was **not** present?
  - Direct: WA beef industry and ranchers
  - Indirect: cattle feeders, beef processors, retailers
  - Induced: consumers, restaurants where ranchers eat
## Results: Output & Prices

<table>
<thead>
<tr>
<th>Sector</th>
<th>Output (%)</th>
<th>Producer Price (%)</th>
<th>Consumer Price (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranch</td>
<td>-6.68</td>
<td>-7.18</td>
<td></td>
</tr>
<tr>
<td>Feedlot</td>
<td>-6.60</td>
<td>-8.44</td>
<td></td>
</tr>
<tr>
<td>Meatpacking</td>
<td>-6.20</td>
<td>-5.78</td>
<td>-1.75</td>
</tr>
</tbody>
</table>

- Change from counterfactual to benchmark
- Could compare 2004 data to 2003 data to infer impact, but not a controlled experiment
### Results: Revenue (Sales)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Benchmark ($)</th>
<th>Counterfactual ($)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranch</td>
<td>11,398</td>
<td>13,133</td>
<td>-13.2</td>
</tr>
<tr>
<td>Feedlot</td>
<td>17,283</td>
<td>20,211</td>
<td>-14.5</td>
</tr>
<tr>
<td>Meatpacking</td>
<td>52,980</td>
<td>59,952</td>
<td>-11.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>87,585</strong></td>
<td><strong>100,167</strong></td>
<td><strong>-12.6</strong></td>
</tr>
</tbody>
</table>

- Total includes other sectors not shown in table
- Similar results for returns to labor and capital
Suggested Reading

- Davis, Craig H. 1993. *Regional Economic Impact Analysis & Project Evaluation*
  - For non-technical audience
  - Many examples and case studies


  - Collection of papers justifying input-output analysis
  - Very mathematical and technical

Conclusion

➤ Regional Economic Modeling
➤ Economic Impact Analysis
  • Economic impact predictions from policy or shock in a counterfactual compared to actual data
  • Relatively quick, easy, and cheap for any policy analyst to do

➤ Types of models
  • Input-output: simpler, no prices
  • CGE: more complicated, with prices

➤ Useful tool for policy analysis when there are alternatives
➤ Not an optimizing tool: no recommendations

➤ Disadvantages
  • Poor at long run predictions, one year only
  • No forecasting
  • “Black box” criticism—take a general model and trust it