Introduction to Regional Industry Cluster Analysis

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Objectives

• What are industry clusters?
• What is industry cluster policy?
• What are some techniques for conducting industry cluster analyses?
• What can you gain from industry cluster analysis?
• Resources and guides
Introduction to industry cluster concepts

- Interest in clusters coincides with focus on competitiveness
- Erosion of traditional sources of comparative advantage
- Innovation as growth engine
- Michael Porter’s framework

From Porter (May, 2000)
Porter’s model of competitive advantage

- Four major determinants of competitive advantage
- Clusters as one element
- Clusters are not necessarily regional in scope
- Measurement unclear
- Limited verification

Firm strategy, structure and rivalry

Demand conditions

Factor conditions

Related and supporting industries

Local context “encourages investment and sustained upgrading”

Factor quantity, quality, cost

From Porter (May, 2000; 1990)

What are industry clusters?
A cluster consists of interdependent firms and institutions:

- **Trading sectors**
  - Intermediate suppliers
  - Capital good suppliers
  - Producer services
  - Consultants
  - Contract R&D

- **Related sectors**
  - Similar technologies
  - Share pool of labor
  - Similar strategies

- **Supporting institutions**
  - Education (univ, colleges)
  - Training (cc’s)
  - R&D (univ, fed labs)
  - Development agencies
  - Regulatory agencies

- **Interdependence**: Each member firm’s competitive position depends on one, some, or all other members of the group.
Why care about industry clusters?

Q: Why does success seem to breed success?
A: The benefits of being the first mover.

Q: What do growing knowledge-intensive and high tech sectors need to survive?
A: Opportunities and incentives to learn, create, upgrade.

Q: What do traditional sectors need to survive?
A: Same thing, as historical sources of advantage are ceded to overseas competitors.

Q: What are you overlooking with standard industry analysis alone?
A: Potential strengths, underlying weaknesses, latent opportunities, new ways of tackling old problems.

Q: What can you gain by targeting efforts?
A: Efficient, effective use of scarce development resources.
Policy uses vary according to degree to which cluster concepts inform existing initiatives or serve as the basis for wholly new strategies.

Degree of joint policy coordination around cluster concept

- Low
  - Inform existing programs

- Support emerging clusters

- High
  - Actively promote clusters
The most common approach to cluster policymaking

1. Cluster definition
2. Analysis
3. Findings
4. Policy implications
5. Policy design
6. Implementation

What is industry cluster policy?

Input to analysis
Output from analysis
Example: Environmental technologies cluster

Value chain: Support supply

- Environmental Equipment
- Sustainable goods
- Intermediate suppliers
- Environmental services
- Resources management

Users: Build demand

- Public sector
- Industry
- Consumers

Arrow indicates trading linkage

University-industry linkages, tech transfer, commercialization
Training and trade schools
Buyer-supplier conferences, networking, trade shows
Venture capital
Incubators
Recruitment

Regulation/enforcement
Resource pricing
Purchasing
Compliance assistance
Credits and incentives
Education
Marketing
Recycling services

What is industry cluster policy?
Another approach to cluster policymaking

What is industry cluster policy?
Typical policy needs imply two major types of applied cluster analyses

**General cluster analysis**
- Assessment of linkages and trends in all regional industries
- Comprehensive and detailed
- Application of generalized cluster definition or use of multiple definitions

**Focused cluster analysis**
- Investigation of one dimension of cluster concept -and/or-
- Investigation of one or a few key industry segments
Conducting a cluster study: Challenges

- Relating concepts to measures
- Obtaining necessary data
- Applying data-intensive and complex analytical methods
- Interpreting findings
- Conveying findings
Begin by relating concepts to measures

Three dimensions of measurement:

- **Linkage**: Innovation, labor, inputs
- **Geography**: Localized, non-localized
- **Time**: Existing, declining, emerging or potential
**Linkage dimension**

- **What binds the firms in the cluster together?**
  - **Value-chain clusters:** Firms that are members of the same extended value (product) chain
  - **Labor-based clusters:** Firms that share similar labor requirements (utilize a shared labor pool)
  - **Innovation clusters:** Firms that exchange key information, knowledge that leads to technological improvements or changes
Geographic dimension

- Are member firms co-located in specific regions?
  - Localized: Clusters in which firms are co-located in specific regions of state (or regions that span state borders)
  - Non-localized: Linked firms that are not localized in any particular region but exist across the state or that are concentrated in multiple regions
Time dimension

• At what stage of development are identified “clusters” in?
  
  • Existing: Clusters with significant presence and exemplify particular linkages that are the focus of study; usually presumes expansion
  
  • Declining: Existing clusters that are declining rather than expanding
  
  • Emerging: Clusters that appear to gaining a significant presence but haven’t achieved a critical mass yet
  
  • Potential: Clusters that might emerge given trends, luck, or policy stimulation
## General Features of different methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Pitfalls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert opinion</td>
<td>Easy</td>
<td>Not generalizable</td>
</tr>
<tr>
<td></td>
<td>Inexpensive</td>
<td>No matter how much you believe, it’s still opinion</td>
</tr>
<tr>
<td></td>
<td>Detailed contextual info</td>
<td></td>
</tr>
<tr>
<td>Specialization indicators (LQs)</td>
<td>Easy, inexpensive</td>
<td>Focus is on sectors, not clusters</td>
</tr>
<tr>
<td></td>
<td>Can supplement methods</td>
<td></td>
</tr>
<tr>
<td>Input-output: Trade</td>
<td>Only major source of data on interdependence in U.S.</td>
<td>May be dated</td>
</tr>
<tr>
<td></td>
<td>Comprehensive and detailed</td>
<td>Industry definitions imperfect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neglects supporting institutions</td>
</tr>
<tr>
<td>Input-output: Innovation</td>
<td>Key measure of interdependence</td>
<td>Data not available in U.S. (see OECD activities)</td>
</tr>
<tr>
<td>Staffing patterns: Labor</td>
<td>Can be used to identify labor affinities</td>
<td>Occupation rather than skills based; fairly aggregate</td>
</tr>
<tr>
<td>Graph theory/ network analysis</td>
<td>Visualization aids</td>
<td>Methods, software still limited</td>
</tr>
<tr>
<td>Surveys</td>
<td>Flexibility to collect ideal data; current</td>
<td>Costly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficult to implement properly</td>
</tr>
</tbody>
</table>
Framing helps determine approach

Identify and frame the policy problem first, i.e., **KNOW WHAT YOU WANT**

**Policy problem:** What will you use the study for?

**Cluster definition**
- Existing?
- Potential or emerging?
- Spatial or non-spatial?
- Type of linkage?

**Methodology**
- Comprehensive?
- Generalizable?
- Qualitative?
- Quantitative?

**Implementation**
- Industry buy-in?
- Analysis only?
- Marketing only?
Focus on value-chain and labor clusters

- No applicable data to identify innovation-based clusters
- Value-chain and labor based clusters can provide good first approximation to innovation-based clusters
- Qualitative methods can be used to identify innovation linkages within VC or labor clusters
Value-chain clusters: Identify interdependencies

**Current, local**
- **Trade-based**
  - Regional input-output
  - Simple descriptive indicators
  - Survey (of existing linkages)
  - Expert opinion
- **Supporting institutions**
  - Survey
  - Interviews
  - Expert opinion

**Emerging/potential**
- **Trade-based**
  - National input-output
  - Available studies of i-o relations
  - Simple descriptive indicators
  - Survey (of buyer-supplier needs)
- **Supporting institutions**
  - Survey (of other needs)
  - Secondary data
  - Expert opinion

How to do a cluster analysis
Two methods of VC cluster analysis

**Bottom-up method:** Identify value chain for a single sector by finding key first, second, third tier suppliers

- Metal stampings, n.e.c.
- Logging
- Petroleum refining
- Veneer and plywood

- Sawmills and planing mills
- Non-upholstered wood furniture

- If an intermediate goods industry, also find key buying sectors
- Regional input-output approximates local trading patterns
- National input-output approximates potential trading patterns
- Use other methods to identify related sectors and supporting institutions
Two methods of VC cluster analysis

Top-down method: Identify an exhaustive set of industry clusters through comprehensive analysis of interdependence between all sectors.

- Detailed interindustry transactions data: For each sector, sales to and purchases from every other sector
- Apply data reduction techniques (factor analysis, statistical cluster analysis, etc.)

Result: Cluster Templates

- Cluster 1
- Cluster 2
- Cluster n
Benchmark U.S. manufacturing clusters

Heavy manufacturing:
- Metalworking
- Vehicle manufacturing
- Brake & wheel products
- Chemicals & rubber
- Concrete, cement, brick
- Petroleum refining
- Nonferrous metals
- Aluminum

Light manufacturing:
- Wood products
- Printing & publishing
- Electronics & computers
- Platemaking & typesetting
- Earthenware products
- Knitted goods
- Fabricated textiles
- Leather goods
- Aerospace

Independent industries:
- Packaged foods
- Canning & bottling
- Feed products
- Dairy products
- Meat products
- Tobacco

Food goods & tobacco
### Features of benchmark clusters

- Amounts to value chain-based rather than product-based manufacturing classification system
- 3- and 4-digit SIC industries may be members of multiple clusters
- Each cluster includes direct and indirect trading partners
- Includes measure of strength of linkage between component sector and broader cluster
- Reasonable initial estimate of interdependent industries even where trading links don’t exist
- Can be easily combined with qualitative cluster analysis methods

<table>
<thead>
<tr>
<th>Cluster</th>
<th>No. of Sectors</th>
<th>2-Digit SIC Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metalworking</td>
<td>116</td>
<td>10</td>
</tr>
<tr>
<td>Vehicle Manufacturing</td>
<td>58</td>
<td>16</td>
</tr>
<tr>
<td>Chemicals &amp; Rubber</td>
<td>48</td>
<td>14</td>
</tr>
<tr>
<td>Electronics &amp; Computers</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>Packaged Foods</td>
<td>44</td>
<td>5</td>
</tr>
<tr>
<td>Printing &amp; Publishing</td>
<td>32</td>
<td>8</td>
</tr>
<tr>
<td>Wood Products</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>Knitted Goods</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Fabricated Textile Products</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Nonferrous Metals</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Canned &amp; Bottled Goods</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Leather Goods</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Aerospace</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Feed Products</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Platemaking &amp; Typesetting</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Aluminum</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Brake Products</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Concrete, Cement, &amp; Brick</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Earthenware Products</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Tobacco Products</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>
## Aerospace: Illustration of a Value-Chain

<table>
<thead>
<tr>
<th>Input output code</th>
<th>SIC sector</th>
<th>Description</th>
<th>Loading</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>600200</td>
<td>3724, 3764</td>
<td>Aircraft and missile engines and engine parts</td>
<td>.92</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600100</td>
<td>3721</td>
<td>Aircraft</td>
<td>.90</td>
<td>13</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>130100</td>
<td>3761</td>
<td>Guided missiles and space vehicles</td>
<td>.82</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600400</td>
<td>3728, 3769</td>
<td>Aircraft and missile equipment, n.e.c.</td>
<td>.70</td>
<td>13</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>380900</td>
<td>3356</td>
<td>Nonferrous rolling and drawing, n.e.c.</td>
<td>.69</td>
<td>13</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>381400 (s)</td>
<td>3463</td>
<td>Nonferrous forgings</td>
<td>.59</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>430100 (s)</td>
<td>3511</td>
<td>Turbines and turbine generator sets</td>
<td>.58</td>
<td>1</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>381300 (s)</td>
<td>3364, 3369</td>
<td>Nonferrous castings, n.e.c.</td>
<td>.56</td>
<td>10</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>620101 (s)</td>
<td>381</td>
<td>Search and navigation equipment</td>
<td>.41</td>
<td>4</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>560500 (s)</td>
<td>3663, 3669</td>
<td>Communication equipment</td>
<td>.36</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(s) indicates secondary sector

- **Loading** indicates strength of linkage between sector and cluster
- **Column labeled ‘cluster ID’** indicates codes for other clusters in which sector is a member
- **Secondary sectors** are those only moderately tied to the cluster
Methods:
Analysis with Labor-Based Industry Clusters

U.S. Staffing Patterns Matrix
501 Occupations
241 Industries
1996, Projected 2006 Employment

Statistical Cluster Analysis
of 501 x 241 labor requirements matrix
on shares of workforce in each occupation

Statistical Cluster Analysis
of 501 x 241 labor requirements matrix
staffing patterns defined in 0/1 form

Judgement

Analysis of regional trends with labor cluster “templates” similar to top-down VC approach
Illustration I: North Carolina cluster project

- Policy need:
  - Target technology adoption programs more effectively

- Economic rationale:
  - Technologies diffuse through value chain, focused analysis

- Cluster definition:
  - Potential and emerging clusters, value-chain based

- Methodology:
  - Input-output based, top down approach

- Implementation:
  - Primarily analysis, planning for manufacturing sector
Illustration II: Scranton/Wilkes-Barre

- **Policy need:**
  - Develop a strategic plan for technology-related development
- **Economic rationale:**
  - No a priori rationale based on policy need, general analysis
- **Cluster definition:**
  - Existing, emerging and potential, value-chain, labor
- **Methodology:**
  - Bottom-up input-output, labor cluster analysis
- **Implementation:**
  - Primarily analysis to inform planning efforts

How to do a cluster analysis
North Carolina project scope

Identify U.S. value chains ('template' clusters)

Examine presence of chains in North Carolina

Spatial distribution
- Statewide study
- 7 regional studies
- GIS-based analysis

Specializations and gaps
- Structure (breadth)
- Size (depth)
- Technology

Growth and turbulence
- Overall growth
- Growth sectors
- Expansions, contractions

How to do a cluster analysis
What can be done with national-level value chains at the state or regional level?

- Look for relative presence of each chain in the state or region
- Look for components of the chain present
- Determine why some elements of the chain are missing
- Determine why other elements are present
- Combine with other methods (surveys, regional input-output) to examine regional trading patterns
- Do not assume regional economy should parallel national economy, but do use templates to better understand your current industry mix
- Chains may serve as the basis for identifying the challenges and opportunities facing the region’s industry
Vehicle manufacturing an NC strength revealed by top-down cluster analysis

- SIC 37, transportation equipment industry accounts for 2.5 percent of state value-added and 3 percent of employment.
- The vehicle manufacturing cluster is the second-largest in the state.
- Growth of the cluster is most pronounced in central and western parts of the state.
- Pattern and nature of cluster growth is consistent with national southward shift of auto production.

Area: Regional shares of statewide vehicle manufacturing cluster employment, 1989

Outline: Regional shares of statewide VF cluster employment growth, 1989-1994
North Carolina value-chains specialized in lower-productivity, lower wage sectors

How to do a cluster analysis

Share of total cluster value-added in high productivity sectors, 1994

United States
North Carolina

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Metalworking linkages likely tighter in Triangle than Southeast region

How to do a cluster analysis

Length of line from origin indicates number of employees in given sector; Axis dimensions range from 0 (at center) to 3,000 at edge.

Axes are sectors that make up the cluster, ordered clockwise by the strength of the linkage between the sector and overall cluster.
**Scranton/Wilkes-Barre project scope**

- Identify key sources of industrial growth during 1990s
  - Specializations
  - High growth sectors relative to the U.S., controlling for national trends
  - Start-up activity

- Identify groups of industries (industry clusters) whose members a strong degree of potential interdependence and shared competitiveness

- Identify any emerging industries that could take advantage of existing up- and downstream industrial activity

- Identify supplier and purchasing sectors that might constitute viable development targets

- Focus on higher value, higher technology sectors
Study Developed overlapping evidence

- Value Chain Analysis
- Basic Industry Trends
- Labor Cluster Analysis
Step 1: Basic Industry Analysis

- Specializations (LQ > 1.2)
- Positive Competitive shift
- Strong Start-up Activity
Step 2: Labor cluster analysis

- Specializations (LQ > 1.2)
- Positive Competitive shift
- Strong Start-up Activity

How to do a cluster analysis
Step 3: Bottom up cluster analysis

1. Identification of 1st and 2nd tier supplier and purchasing chains for each of 413 basic industries

2. Examination of characteristics of each chain

3. Identification of core regional industries

4. Reduced Set of regional industries with strong or emerging potential up- and/or downstream linkages

Value Chain Analysis

- Size
- Breadth (sectors present in region)
- Specialization, current and trend
- Expansion (aggregate and share growth sectors)
- Depth (diversity, trend in diversity)

Core Industry Analysis

- Size
- Specialization, current and trend
- Expansion (absolute and relative)

Potential regional cluster industries

Study sector (i, . . . , j=413)

Supplier sector i
Supplier sector j
Supplier sector k

Purchasing sector i
Purchasing sector j
Purchasing sector k

How to do a cluster analysis
Step 4: Interpret overlapping evidence

- Look for consistent results across analyses: VC clusters should overlap with labor clusters

- Weakness of approach
  - Interpretation involves considerable ‘art’

- Strength of approach
  - The notion of a single set of “clusters” for a given region unreasonable except at the most aggregate level
  - Provides a level of detail that can facilitate strategic planning
  - Can serve as a framework for continuous monitoring
Summary thoughts

• Think policy needs first
• Identify appropriate clustering dimension to focus on
• Are localized clusters what you’re after?
• Existing, emerging, potential?
• Utilize existing studies (e.g., “templates”), at least as a start
• If you commission a study, demand the following:
  – Full and detailed disclosure of all methods and data
  – An actual assessment of interdependence, not just specialization
  – Follow-up interpretation and support
Available guides


“National industry cluster templates: A framework for applied regional cluster analysis,” by E. Feser and E. Bergman, Forthcoming Regional Studies, 1999. (Contains all data in this presentation.)


