Clusters, Innovation, and Competitiveness: New Findings and Implications for Policy

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Stockholm, Sweden
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Additional information may be found at the website of the Institute for Strategy and Competitiveness, www.isc.hbs.edu
The Changing Nature of International Competition

- Falling restraints to trade and investment
- Globalization of markets
- Globalization of value chains
- Shift from vertical integration to relying on outside suppliers, partners, and institutions
- Increasing knowledge and skill intensity of competition

• Nations and regions compete on becoming the most productive locations for business
Outline

• The role of clusters in overall competitiveness

• How clusters work

• The impact of clusters on regional prosperity and innovation

• Cluster policy

• Some implications for Europe
Clusters and Competitiveness

Macroeconomic, Political, Legal, and Social Context

Microeconomic Competitiveness

- Sophistication of Company Operations and Strategy
- Quality of the Business Environment
- State of Cluster Development

Quality of the Business Environment

Sophistication of Company Operations and Strategy

State of Cluster Development
Clusters and Innovation
Determinants of Innovative Capacity

Innovative Capacity

- Company Innovation Orientation
- Common Innovation Infrastructure
- Quality of Linkages
- Cluster-Specific Conditions
What is a Cluster?

A geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities (external economies)

- An end product industry or industries
- Downstream or channel industries
- Specialized suppliers
- Providers of specialized services
- Related industries (those with important shared activities, labor, technologies, channels, or common customers)
- Supporting Institutions: financial, training, trade associations, standard setting, research

- Clusters vs. industries
- Clusters vs. sectors
Enhancing Cluster Development
Tourism Cluster in Cairns, Australia

Public Relations & Market Research Services
Food Suppliers
Property Services
Maintenance Services

Travel agents
Tour operators

Restaurants
Attractions and Activities e.g., theme parks, casinos, sports
Hotels
Airlines, Cruise Ships

Local retail, health care, and other services
Local Transportation
Souvenirs, Duty Free
Banks, Foreign Exchange

Government agencies e.g. Australian Tourism Commission, Great Barrier Reef Authority
Educational Institutions e.g. James Cook University, Cairns College of TAFE
Industry Groups e.g. Queensland Tourism Industry Council

Sources: HBS student team research (2003) - Peter Tynan, Chai McConnell, Alexandra West, Jean Hayden

European Cluster Policy 01-22-08 CK

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The Boston Life Sciences Cluster

Health and Beauty Products
Surgical Instruments and Suppliers
Medical Equipment
Dental Instruments and Suppliers
Ophthalmic Goods
Diagnostic Substances
Containers
Analytical Instruments

Teaching and Specialized Hospitals

Biological Products
Biopharmaceutical Products

Research Organizations

Cluster Organizations
MassMedic, MassBio, others

Specialized Business Services
Banking, Accounting, Legal

Specialized Risk Capital
VC Firms, Angel Networks

Specialized Research Service Providers
Laboratory, Clinical Testing

Educational Institutions
Harvard University, MIT, Tufts University, Boston University, UMass
Clusters and Competitiveness

• Clusters Increase Productivity / Efficiency
  – **Efficient access** to specialized inputs, services, employees, information, institutions, training programs, and other “public goods” (local outsourcing)
  – Ease of **coordination** and transactions across firms
  – Rapid **diffusion** of best practices
  – Ongoing, visible **performance comparisons** and strong incentives to improve vs. local rivals
  – Proximity of rivals encourages strategic differentiation

• Clusters Stimulate and Enable Innovations
  – Greater likelihood of **perceiving innovation opportunities** (e.g., unmet needs, sophisticated customers, combinations of services or technologies)
  – Presence of multiple suppliers and institutions to assist in **knowledge creation**
  – Ease of **experimentation** given locally available resources

• Clusters Facilitate Commercialization and New Business Formation
  – Opportunities for **new companies** and **new lines of established business** are more apparent
  – **Spinoffs and startups** are encouraged by the presence of other companies, commercial relationships, and concentrated demand
  – **Commercializing** new products and starting new companies is easier because of available skills, suppliers, etc.

• Clusters reflect the fundamental influence of **linkages and spill-overs** across firms and associated institutions in competition
Institutions for Collaboration
Selected Massachusetts Organizations, Life Sciences

**Life Sciences Industry Associations**
- Massachusetts Biotechnology Council
- Massachusetts Medical Device Industry Council
- Massachusetts Hospital Association

**General Industry Associations**
- Associated Industries of Massachusetts
- Greater Boston Chamber of Commerce
- High Tech Council of Massachusetts

**Economic Development Initiatives**
- Massachusetts Technology Collaborative
- Mass Biomedical Initiatives
- Mass Development
- Massachusetts Alliance for Economic Development

**University Initiatives**
- Harvard Biomedical Community
- MIT Enterprise Forum
- Biotech Club at Harvard Medical School
- Technology Transfer offices

**Informal networks**
- Company alumni groups
- Venture capital community
- University alumni groups

**Joint Research Initiatives**
- New England Healthcare Institute
- Whitehead Institute For Biomedical Research
- Center for Integration of Medicine and Innovative Technology (CIMIT)
Cluster Specialization
Selected Footwear Clusters

**Portugal**
- Production
- Focus on short-production runs in the medium price range

**Romania**
- Production subsidiaries of Italian companies
- Focus on lower to medium price range

**China**
- OEM Production
- Focus on low cost segment mainly for the US market

**United States**
- Design and marketing
- Focus on specific market segments like sport and recreational shoes and boots
- Manufacturing only in selected lines such as hand-sewn casual shoes and boots

**Italy**
- Design, marketing, and production of premium shoes
- Export widely to the world market

**Brazil**
- Low to medium quality finished shoes, inputs, leather tanning
- Shift toward higher quality products in response to Chinese price competition

**Vietnam/Indonesia**
- OEM Production
- Focus on the low cost segment mainly for the European market

Source: Research by HBS student teams in 2002 – Van Thi Huynh, Evan Lee, Kevin Newman, Nils Ole Oerrmann
The Australian Wine Cluster
Milestones

1930
First oenology course at Roseworthy Agricultural College

1955
Australian Wine Research Institute founded

1965
Australian Wine Bureau established

1970
Winemaking school at Charles Sturt University founded

1980
Australian Wine and Brandy Corporation established

1990
Winemaker’s Federation of Australia established

1991 to 1998
New organizations created for education, research, market information, and export promotions

1950s
Import of European winery technology

1960s
Recruiting of experienced foreign investors, e.g. Wolf Bass

1970s
Continued inflow of foreign capital and management

1980s
Creation of large number of new wineries

1990s
Surge in exports and international acquisitions

# The Composition of Regional Economies

**United States, 2004**

<table>
<thead>
<tr>
<th></th>
<th>Traded</th>
<th>Local</th>
<th>Natural Resource-Driven</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Share of Employment</strong></td>
<td>29.3%</td>
<td>70.0%</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Employment Growth Rate, 1990 to 2004</strong></td>
<td>0.7%</td>
<td>2.4%</td>
<td>-1.2%</td>
</tr>
<tr>
<td><strong>Average Wage</strong></td>
<td>$49,367</td>
<td>$30,416</td>
<td>$35,815</td>
</tr>
<tr>
<td><strong>Relative Wage</strong></td>
<td>137.2%</td>
<td>84.5</td>
<td>99.5</td>
</tr>
<tr>
<td><strong>Wage Growth</strong></td>
<td>4.2%</td>
<td>3.4%</td>
<td>2.1%</td>
</tr>
<tr>
<td><strong>Relative Productivity</strong></td>
<td>144.1</td>
<td>79.3</td>
<td>140.1</td>
</tr>
<tr>
<td><strong>Patents per 10,000 Employees</strong></td>
<td>23.0</td>
<td>0.4</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Number of SIC Industries</strong></td>
<td>590</td>
<td>241</td>
<td>48</td>
</tr>
</tbody>
</table>

Note: 2004 data, except relative productivity which uses 1997 data.
Broad Composition of Regional Economies

Traded versus Local Wages

Local Wages, 2003

Traded Wages, 2003

- San Jose-San Francisco-Oakland, CA
- Reno, NV
- Las Vegas, NV
- Anchorage, AK
- Raleigh-Durham-Cary, NC
- New York-Newark-Bridgeport, NY-NJ-CT-PA

y = 0.3205x + 13038

$R^2 = 0.6493$

p-value < 0.001
Specialization of Regional Economies
Selected U.S. Geographic Areas

Note: Clusters listed are the three highest ranking clusters in terms of share of national employment.
Innovation Performance of Regions
Patenting Intensity, U.S. Economic Areas

Innovation Performance of Regions
Patenting Intensity, European NUTS 2 Regions

Source: Eurostat (2008)
## Automotive Cluster

### Narrow Cluster Definition

<table>
<thead>
<tr>
<th>SUBCLUSTERS (16)</th>
<th>SIC</th>
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<tbody>
<tr>
<td><strong>Motor Vehicles</strong></td>
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<td></td>
<td>3230</td>
<td>Products of purchased glass</td>
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<td></td>
<td>3592</td>
<td>Carburetors, pistons, rings, valves</td>
</tr>
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<td>3714</td>
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<td>Rubber and plastics hose and belting</td>
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<td>3061</td>
<td>Mechanical rubber goods</td>
</tr>
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<td><strong>Forgings and Stampings</strong></td>
<td>3322</td>
<td>Malleable iron foundries</td>
</tr>
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<td>3465</td>
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<tr>
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<td><strong>Production Equipment</strong></td>
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<td>Transportation equipment, n.e.c.</td>
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<td>Internal combustion engines, n.e.c.</td>
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Automotive Clusters by Economic Areas, 1997

- Regions with high share of US automotive employment (in top 10% of all regions; share > 1.5%) & high cluster specialization (LQ > 1.7)
- Adjacent EAs tend to specialize in the same
- Regions with high cluster specialization (LQ > 1.7; LQ_{c,r} > LQ_c 80-th Percentile)
- Weak clusters with large employment size in high population areas
Regions with high share of US financial services employment (in top 10% of all regions; share>2.5%) & high cluster specialization (LQ>1.01)

Regions with high cluster specialization (LQ>1.03; LQ_{c,r} > LQ_{c} 80-th Percentile)

Weak clusters with large employment size in high population areas
Cluster Employment Strength and Wages

U.S. Economic Areas

\[ y = 6077.8x + 25158 \]

\[ R^2 = 0.3371 \]

\[ p\text{-value} < 0.001 \]

Note: Cluster strength is measured as share of regional traded employment in strong clusters (weighting by the overlap among the strong clusters.)

# Automotive Cluster

## Broad Cluster Definition

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<td>3519</td>
<td>Internal combustion engines, n.e.c.</td>
</tr>
<tr>
<td><strong>Related Parts</strong></td>
<td>3364</td>
<td>Nonferrous die-casting, except aluminum</td>
</tr>
<tr>
<td></td>
<td>3452</td>
<td>Bolts, nuts, rivets, and washers</td>
</tr>
<tr>
<td></td>
<td>3493</td>
<td>Steel springs, except wire</td>
</tr>
<tr>
<td></td>
<td>3495</td>
<td>Wire springs</td>
</tr>
<tr>
<td></td>
<td>3562</td>
<td>Ball and roller bearings</td>
</tr>
<tr>
<td></td>
<td>3566</td>
<td>Speed changers, drives, and gears</td>
</tr>
<tr>
<td></td>
<td>3641</td>
<td>Electric lamps</td>
</tr>
<tr>
<td><strong>Motors and Generators</strong></td>
<td>3621</td>
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</tr>
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<td>3795</td>
<td>Tanks and tank components</td>
</tr>
<tr>
<td><strong>Metal Processing</strong></td>
<td>3316</td>
<td>Cold finishing of steel shapes</td>
</tr>
<tr>
<td></td>
<td>3398</td>
<td>Metal heat treating</td>
</tr>
<tr>
<td><strong>Machine Tools</strong></td>
<td>3541</td>
<td>Machine tools, metal cutting types</td>
</tr>
<tr>
<td></td>
<td>3542</td>
<td>Machine tools, metal forming types</td>
</tr>
<tr>
<td></td>
<td>3545</td>
<td>Machine tool accessories</td>
</tr>
<tr>
<td><strong>Related Process Machinery</strong></td>
<td>3543</td>
<td>Industrial patterns</td>
</tr>
<tr>
<td></td>
<td>3548</td>
<td>Welding apparatus</td>
</tr>
<tr>
<td><strong>Industrial Trucks and Tractors</strong></td>
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</tr>
<tr>
<td><strong>Die-castings</strong></td>
<td>3363</td>
<td>Aluminum die-castings</td>
</tr>
</tbody>
</table>
Note: Clusters with overlapping borders or identical shading have at least 20% overlap (by number of industries) in both directions.
The Evolution of Regional Economies

San Diego

- Climate and Geography
- U.S. Military

- Bioscience Research Centers
- Hotspot / Bioscience Research Centers
- Education and Knowledge Creation
- Medical Devices
- Biotech / Pharmaceuticals
- Communications Equipment
- Information Technology
- Power Generation
- Aerospace Vehicles and Defense
- Analytical Instruments
- Transportation and Logistics
- Sporting Goods
- Hospitality and Tourism

Clusters and Regional Prosperity
Recent Findings

Higher Regional Job Growth, Wages, and Patenting

- Specialization in **strong clusters**
- **Breadth** of positions within clusters
- Positions in **related clusters**
- Region‘s clusters also present in **neighboring regions**

**Not significant**
- Positions in High-Tech versus other clusters

The Process of Economic Development
Shifting Roles and Responsibilities

**Old Model**

- **Government** drives economic development through policy decisions and incentives

**New Model**

- Economic development is a **collaborative process** involving government at multiple levels, companies, teaching and research institutions, and institutions for collaboration

- Competitiveness must be a **bottoms-up process** in which many individuals, companies, and institutions take responsibility

- Clusters provide a platform to address the **specific barriers** companies face in a given market, not just general challenges all companies are exposed to
Clustering and Economic Policy Dimensions

- Clusters as a platform to inform public policy
- Clusters as a means of implementing economic policies
- Cluster initiatives that mobilize public private efforts to improve the business environment and capture spillovers
Clusters and the Implementation of Economic Policy

• Clusters provide a framework for **formulating and implementing** effective public policies and making public investments to foster economic development.
Principles of Cluster Policy

• **Neutral** across clusters

• Enhancing productivity of **multiple firms/institutions**

• Facilitating/capturing **linkages and externalities**

• Facilitating the flow of **information/knowledge** across actors

• Engaging the **private sector**, not just government

• Preserving and enhancing market **competition**, not retarding it
Improving the Cluster-Specific Business Environment

- **Factor (Input) Conditions**
  - I.e., Investments in specialized
    - Physical infrastructure
    - Research facilities
    - Workforce development programs

- **Demand Conditions**
  - I.e., Improving the sophistication of local demand
    - Public procurement programs
    - Environmental, health, quality, or consumer protection standards

- **Related and Supporting Industries**
  - I.e., Attracting supporting industries

- **Context for Firm Strategy and Rivalry**
  - I.e., Improving the investment climate
    - Depreciation rules

- Policies need to have an **impact on productivity and innovation**, not just transfer money
- Policies need to change the environment for **many companies in the cluster**, not just a few
Cluster Strength in Europe versus the United States

Share of Employment in Strong Clusters

Europe
United States

Source: European Cluster Observatory
European Cluster Policy 01-22-08 CK

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Clusters and European Regional Prosperity
Cluster Strength and Prosperity, EU-15 NUTS 2 Regions

GDP per Capita (PPP adjusted), 2004

Note: Strong clusters defined by LQ>2; NUTS Regions excluding Portugal and Greece.
Source: European Cluster Observatory. ISC/CSC cluster codes 1.0, dataset 20070510
Implications for Europe

• Specialization in a set of clusters what drives competitiveness and innovation, not homogenization

• Limited regional specialization is an important determinant of Europe’s lagging competitiveness

• Further integration of European markets is essential to enable a more efficient economic geography and stronger clusters

• Government can be an important actor in European cluster policy but government must play the right role
  – Government must act as facilitator, not the driver
  – Government responsibilities for cluster development should be allocated across geographic levels, with a focus on the regional level
  – European support for cluster development must be based on competitive principles
Back-Up
Cluster Employment Strength and Wages
U.S. Economic Areas

Economic Area Cluster Employment Strength, 2003

Economic Area Average Wage, 2003

San Jose-San Francisco-Oakland, CA
New York-Newark-Bridgeport, NY-NJ-CT-PA
Boston-Worcester-Manchester, MA-NH

y = 7662.6x + 25257
R² = 0.1766
p-value < 0.001

Note: Cluster strength is measured as share of regional traded employment in strong clusters (weighting by the overlap among the strong clusters.)